STATEWIDE FISHERIES SURVEYS, 2003
SURVEY OF PUBLIC WATERS
Part 1
Lakes - Region I

South Dakota
Department of
Game, Fish and Parks
Wildlife Division
Joe Foss Building
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Annual Report
No. 04-11

STATEWIDE FISHERIES SURVEYS, 2003

SURVEYS OF PUBLIC WATERS

by
Gene Galinat
and
Bill Miller

(Annual Report)

Part 1 Lakes
Region I

Dingell-Johnson Project..... F-21-R-36

Job Number..... 2102

Date..... July 2004

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INTRODUCTION

Data gathered from May through October 2003 in State Management Region I are contained in this report. The Missouri River System and other State Management Regions are contained in separate reports.

OBJECTIVE

To survey waters where data is not sufficient to complete management plans or where optimum sport fishing yields are not realized under existing management and additional information is needed for plan update and remedial action.

PROCEDURE

Individual waters are surveyed to accumulate and update physical, chemical, and biological data. A review of existing information accompanied new data collections. Information collected was recorded on a narrative type form developed for the new South Dakota Fisheries Investigations Manual.

FINDINGS

The findings are contained in the following lake survey report. This reporting method will allow for orderly method of collecting and recording data, making it available for completing and updating management plans and evaluating current management practices.

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-36

Name: Cedar Creek #1 County: Bennett
Legal description: Sec36, T36N, R37N
Location from nearest town: 5miles S, 4.5miles E, 2miles S of Martin, SD
Dates of present survey: June 17-18, 2003
Date last surveyed: July 14-15, 1976
Most recent lake management plan: F-21-R-32 Date: 1999
Management classification: Warmwater permanent
Contour mapped: No

Primary Species: (game and forage)	Secondary and other species:
1. Rainbow trout	1.

PHYSICAL CHARACTERISTICS

Surface Area: 10 acres; Watershed: 320 acres
Maximum depth: 22 feet; Mean depth: 8.5 feet
Lake elevation at survey (from known benchmark): full

1. Describe ownership of lake and adjacent lakeshore property:

Ten percent of the land around the lake is owned by the US Fish and wildlife service. The remainder of the lake is privately owned with an access agreement for public fishing.

2. Describe watershed condition and percentages of land use:

The watershed is entirely made of sand hills which yield very little runoff because of soil type.

3. Describe aquatic vegetative condition:

Very little emergent vegetation exists in the back of some shallow bays.

4. Describe pollution problems:

No pollution problems were identified during the 2003 survey.

5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:

The dam was rebuilt in 1989 and is in excellent condition. No other facilities are located at Cedar Creek Dam.

CHEMICAL DATA

1. Describe general water quality characteristics.

Field measurements included temperature and dissolved oxygen profile, surface pH, surface conductivity and transparency (Appendix B).

2. Thermocline: No

3. Secchi disc reading: 11.Oft.

4. Stations for water chemistry located on attached lake map: No

BIOLOGICAL DATA

Methods

A lake survey was conducted at Ceder Creek Dam on June 17-18, 2003. Sampling consisted of three trap nets and one gill net. All gill nets were monofilament experimental nets. Each net was 45.7-m (150-ft) long and 1.8-m (6-ft) deep with six 7.6-m (25-ft) panels of bar mesh sizes: 12.7-mm (0.5-in), 19.l-mm (0.75-in), 25.4-mm (1.0-in), 31.8-mm (1.25-in), 38.l-mm (1.5-in), and 50.8-mm (2.0-in). All trap nets were modified fyke-nets with a 1.3-X 1.5-m frame, 19.1-mm (0.75-inch) mesh and a 1.2- X 23-m (3.9- X 75.5-ft) lead. Collected fish were measured for total length (TL; mm) and weighed (g). In addition, scale samples for the first five fish per centimeter group were collected from selected fish per gear type for age and growth analysis. Scale samples were pressed onto acetate slides and viewed with a microfiche projector (40X) and the distance between scale annuli were recorded on paper strips. All data was entered into WinFin 2.95 (Francis 1999).

Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch-per-unit-effort (CPUE), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr) based on length categories. Abundance was expressed as the mean catch-per-unit-effort (CPUE; mean number per net night or mean number per hour of electrofishing). Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr.

Results and Discussion

Cedar Creek #1 is a ten acre, spring fed dam near the Lacreek National Wildlife Refuge. A new dam was made in 1989. Since then it has been managed as a put and take rainbow trout fishery. This survey was done to see if other species had invaded the lake and hurt the trout fishery. Sampling consisted of one gill net and three frame nets. Three trout were caught, no other fish were present.

Table 1. Total catch (N), catch per net night (CPUE; 80% CT's in parentheses), catch per net night of stock-length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD-P; 90% CT's in parentheses) for all fish species collected from three, ¾ inch frame nets in Cedar Creek Dam, Bennett County, June 17, 2003.

Species	CPUE
Rainbow trout	0.3(0.6)
total	

Table 2. Total catch (N), catch per net night for all fish species collected from one, 150-ft experimental sinking gill nets in Cedar Creek Dam #1 on June 17-18, 2003.

Species	N	CPUE
Rainbow trout	2	2.0
Total	2	

LITERATURE CITED

Francis, J. 1999. Winfin, Version 2.95; Microsoft Access Program for data entry. Nebraska Game and Parks Commission, Lincoln.

Francis, J. 2000. WinFin Analysis Program. Version 1.5. Nebraska Game and Parks Commission, Lincoln.

RECOMENDATIONS

l. Continue to manage as a rainbow trout only fishery.

APPENDICES

Appendix A. Stocking record for Cedar Creek Dam #1, Bennett County 1993-2003.

Year	Number	Species	Size
1993	6000	RBT	CAT
1994	6000	RBT	CAT
1995	5880	RBT	CAT
	20	RBT	ADT
1996	4705	RBT	CAT
1997	5630	RBT	CAT
1998	1875	RBT	CAT
	40	RBT	ADT

1999	3770	RBT	CAT
	6	RBT	ADT
2000	4655	RBT	CAT
2001	3750	RBT	CAT
2002	3905	RBT	CAT
	20	RBT	ADT
2003	1850	RBT	CAT
	20	RBT	ADT

Appendix B. Water chemistry results from Cedar Creek Dam, Bennett County, June 18, 2003.

Depth (ft)	Temp (^{0}C)	D.O. (mg/l)	pH	Conductivity (umhos/cm)	Secchi disk (ft)
Surface	20.2	7.4	9.3		11.0
2	20.0	7.4			
4	20.0	7.4			
6	20.0	7.4			
8	20.0	7.0			
10	18.0	3.4			
12	17.0	1.2			
14	16.0	0.6			
16	15.0	0.4			
18	15.0	0.4			

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-36

Name: Little White River Project County: Bennett
Legal description: Sec. 14, 23, T 37 N, R 36 W.
Location from nearest town: 2.5 mi W of Tuthill, SD
Dates of present survey: June 16-17, 2003
Date last surveyed: June 26-28, 1995
Most recent lake management plan: F21-R-32 Date: 2000
Management classification: Warmwater permanent
Contour mapped: Date 1986

Primary Species: (game and forage)
1. Black bullhead
2. Black crappie
3. Northern pike
4. Walleye
5. _____

Secondary and other species:
1. Channel catfish
2. Common carp
3. White sucker
4. Northern redhorse
5. Madtom
6. Largemouth bass

PHYSICAL CHARACTERISTICS

Surface Area: 111 acres; Watershed: 130,000 acres
Maximum depth: 9 feet; Mean depth: 4 feet
Lake elevation at survey (from known benchmark): -1 feet

1. Describe ownership of lake and adjacent lakeshore property:

The land surrounding the Little White River Project is owned by the South Dakota Department of Game, Fish and Parks and the US Fish and Wildlife Service. The area is managed as a Game Production Area and a recreation area.

2. Describe watershed condition and percentages of land use:

Agricultural use occurs on approximately 75% of the 204 square mile drainage area. Pastureland makes up the remaining 25%.

3. Describe aquatic vegetative condition:

Cattails surround much of the lake especially on the east and west shoreline. Turbid water keeps submergent vegetation to a minimum.

4. Describe pollution problems:

Sedimentation and consequently, high turbidity occurs due to agricultural run off. No other pollution problems were identified by departmental personnel during the 2003 survey.

4. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:

All structures and the boat ramp appear in good condition.

CHEMICAL DATA

1. Describe general water quality characteristics.
Water chemistry parameters were collected on June 16, 2003 at an established station. Field measurements included temperature and dissolved oxygen profile, surface pH, surface conductivity and transparency (Appendix B).

2. Thermocline: No

3. Secchi disc reading: l.0 ft.

4. Stations for water chemistry located on attached lake map: Yes

BIOLOGICAL DATA

Methods

A lake survey was conducted on Little White River Project June 16-17, 2003. Sampling consisted of 2 gill net nights and 4 trap net nights (Appendix C). All gill nets were monofilament experimental nets. Each net was 45.7 m (150-ft) long and 1.8 m (6-ft) deep with six 7.6 m (25-ft) panels of bar mesh sizes: 12.7 mm (0.5 in), 19.1 mm (0.75 in), 25.4 mm (1.0 in), 31.8 mm (1.25 in), 38.1 mm (1.5 in), and 50.8 mm (2.0 in). Trap nets were set at four stations consisting of one net night each. All trap nets were modified fyke-nets with a 1.3 X l.5-m frame, 19.1 mm (0.75 inch) mesh and a l.2- X 23-m (3.9- X 75.5-ft) lead. Collected fish were measured for total length (TL; mm) and weighed (g). In addition, scale samples for the first five fish per centimeter group were collected from selected fish per gear type for age and growth analysis. Scale samples were pressed onto acetate slides and viewed with a microfiche projector (40X) and the distance between scale annuli were recorded on paper strips. All data was entered into WinFin 2.95 (Francis 1999).

Night electrofishing was conducted at Little White River Project on October 8, 2003. Electrofishing was conducted using a Smith-Root unit with pulsed-DC. A total of six, 10 minute stations were sampled. Water temperature was 16 degrees Celsius. No largemouth bass were observed during this survey.

Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch per unit effort (CPUE), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr) based on length categories. Abundance was expressed as the mean catch per unit effort (CPUE; mean number per net night or mean number per hour of electrofishing). Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr.

Results and Discussion

Overall, eight species of fish were collected during the 2003 lake survey (Tables I and 2) Thirty-two fish were collected by gill net, with common carp (59%) and age zero walleye (28%) being the most numerous (Table 2). Two hundred fifty one fish were collected by frame nets with common carp (45%) and black bullhead (37%) being the most numerous (Table 1). Population parameters of dominant game and forage species in Little White River Project are discussed individually below.

Table 1. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock-length fish (CPUE-S; 80%Cl's), proportional stock densities (PSD, RSD-P; 90% CI's in parentheses), and condition factor (Wr for fish > stock length; 80%CI's) for all fish species collected from four, ¼ inch framenets in the Little White River Project on June 16-17, 2003.

Species		CPUE	CPUE-S	PSD	RSD-P	Wr?: S
Black bullhead	92	23.0(21.4)	--	13(8)	0	80.6(0.5)
Black crappie	30	7.5(11.2)	7.5(11.2)	77(14)	20(13)	100.8(1.0)
Channel catfish	7	1.8(l.7)	l.0(0.9)	0	0	88.3(7.5)
Common carp	112	28.0(35.3)	--	23(10)	15(9)	78.0(1.2)
Northern pike	7	1.8(1.2)	1.8(1.2)	14(28)	0	83.1(9.3)
Tadpole madtom	1	0.3(0.4)	--	--	--	--
Walleye	2	0.5(0.8)	0.3(0.4)	--	--	78.8(-)
Total	251					

Table 2. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD-P; 90% CI's in parentheses), and condition factor (Wr for fish > stock length; 80%CI's) for all fish species collected from two 150-ft experimental sinking gill nets in the Little White River Project on June 16-17, 2003.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr > S
Black bullhead	2	1.0(3.1)	0.0(--)	--	--	--
Common carp	19	9.5(4.6)	--	23(11)	15(9)	74.3(2.8)
Northern pike	1	0.5(1.5)	0.5(1.5)	--	--	85.9
Walleye	9	4.5(l.5)	0.0(--)	0(--)	0(--)	--
Yellow perch	1	0.5(1.5)	0.5(1.5)	--	--	89.9
Total	32					

Table 4. Little White River Project black crappie year class, age in 2003, sample size (N), mean back-calculated total length at age, population standard error (SE), and the South Dakota black crappie mean length at age (Willis et al. 2001).

Year Class	Age	N	Age 1	2	3	4	5
2001	2	22	117	209			
2000	3	2	115	228	267		
1999	4	3	98	211	263	299	
1998	5	1	83	196	232	265	299
Sample size		28					
2003 Mean(SE)			**103(8)**	**211(7)**	**254(11)**	**282(17)**	**299(0)**
South Dakota(SE)			83(2)	147(4)	195(5)	229(6)	249(6)

Common Carp

Common carp were the most abundant species sampled during the 2003 survey. Frame net CPUE was 28.0 and gill net CPUE was 9.5 (Table 1&2). These numbers were much higher than the previous survey in 1995, when frame net CPUE was 0.9 and the gillnet CPUE was 0.0. Length frequency showed many different sizes of carp indicating good recruitment (Figure 3).

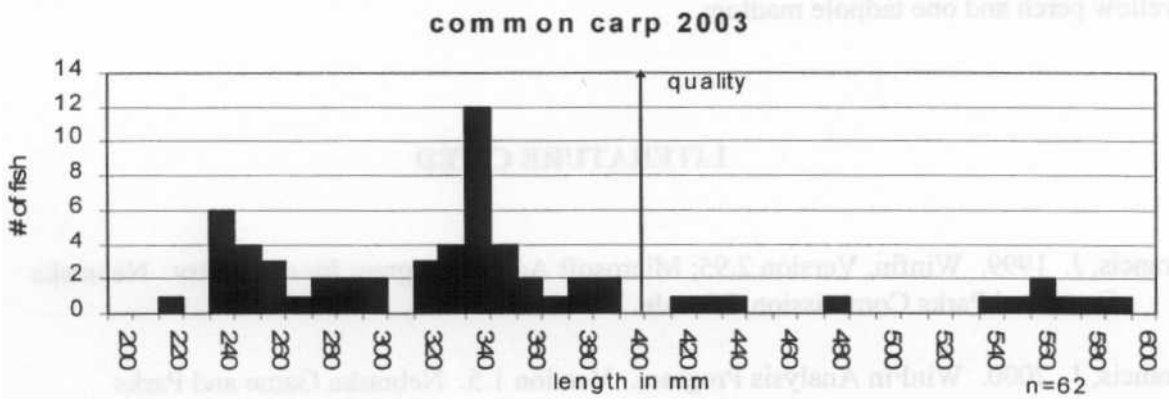


Figure 3. Length frequency histogram for common carp from frame nets at Little White River Project.

Northern Pike

Pike density was low with a gill net CPUE of 0.5 and a frame net CPUE of l.8 (Table I and 2). Of the eight fish measured, two were over the quality length of 21 inches. Condition was poor with a Wr for stock length and larger fish of 83.1 (Table 1).

Walleye/Saugeye

In the past ten years, 187,000 walleye/saugeye have been stocked at LWRP. Obviously this is not creating much of a fishery as the largest fish sampled was 10 inches (Figure 4). Gill net CPUE was 4.5, none of which were over stock length (10-inches). Condition was poor as

Black Bullhead

Little White River Project has a moderately abundant black bullhead population. Frame net CPUE was 23.0. The two gill nets sampled two substock bullheads. Size structure revealed a population dominated by small fish with a PSD of 13 and a RSD-P of 0. Fish condition was poor with a Wr for stock length and larger fish of 80.6.

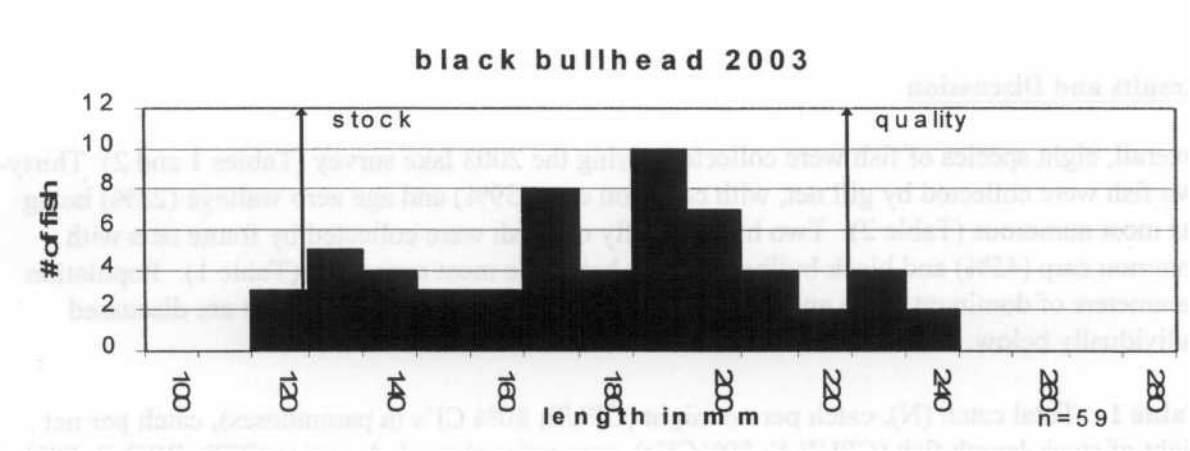


Figure 1. Length frequency histogram for black bullhead from frame nets at Little White River Project.

Black Crappie

Black crappie were the dominate panfish in Little White River Project with a frame net CPUE of 7.5. Stock indices indicated a large percentage of larger fish (Figure2). PSD was 77 with a RSD-P of 20 and a RSD-M of 13. Fish condition was excellent with a Wr of stock length and larger fish of 100.8. Growth was excellent with an average three year old measuring 10 inches (Table 3).

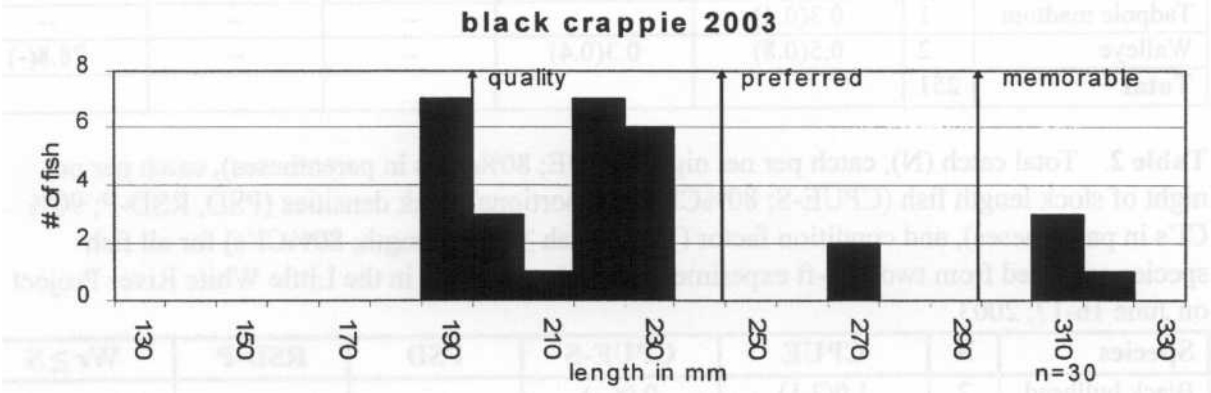


Figure 2. Length frequency histogram for black crappie from frame nets at Little White River Project.

substock fish had a mean Wr of 82.3. Walleye/saugeye fingerlings have been stocked nine out of the last eleven years. With no visible year classes recruited to the population, it appears time to give up on small walleye fingerlings as an option on this lake.

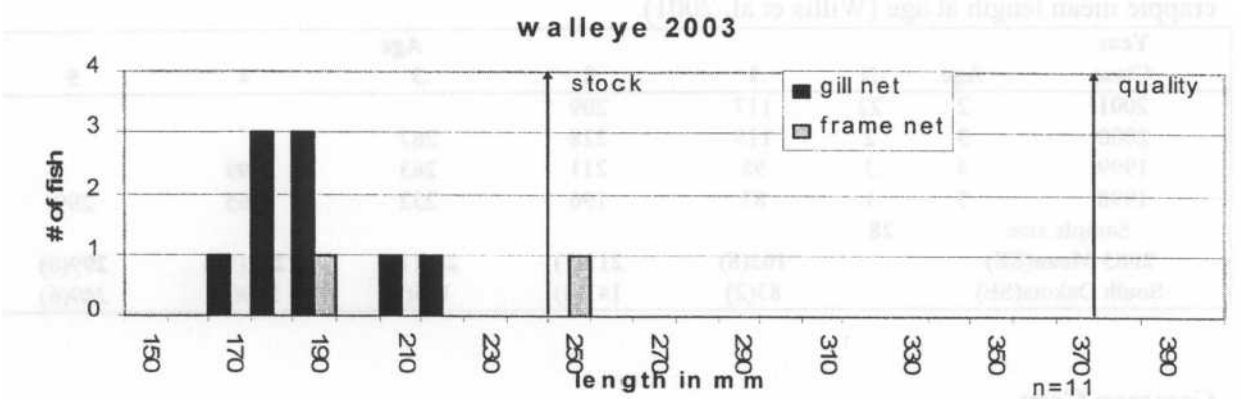


Figure 4. Length frequency histogram for walleye from gill nets and frame nets at Little White River Project.

Other Species

Three other species were sampled during the survey. They include seven channel catfish, one yellow perch and one tadpole madtom.

LITERATURE CITED

Francis, J. 1999. Winfin, Version 2.95; Microsoft Access Program for data entry. Nebraska Game and Parks Commission, Lincoln.

Francis, J. 2000. WinFin Analysis Program. Version 1.5. Nebraska Game and Parks Commission, Lincoln.

Willis, D.W., D.A. Isermann, M.J. Hubers, B.A. Johnson, W.H. Miller, T.R. St. Sauver, J.S. Sorenson, E.G. Unkenholz, and G.A. Wickstrom. 2001. Growth of South Dakota Fishes

RECOMMENDATIONS

1. Discontinue small fingerling stockings of walleye in LWRP.

2. Manage as a northern pike/black crappie fishery.

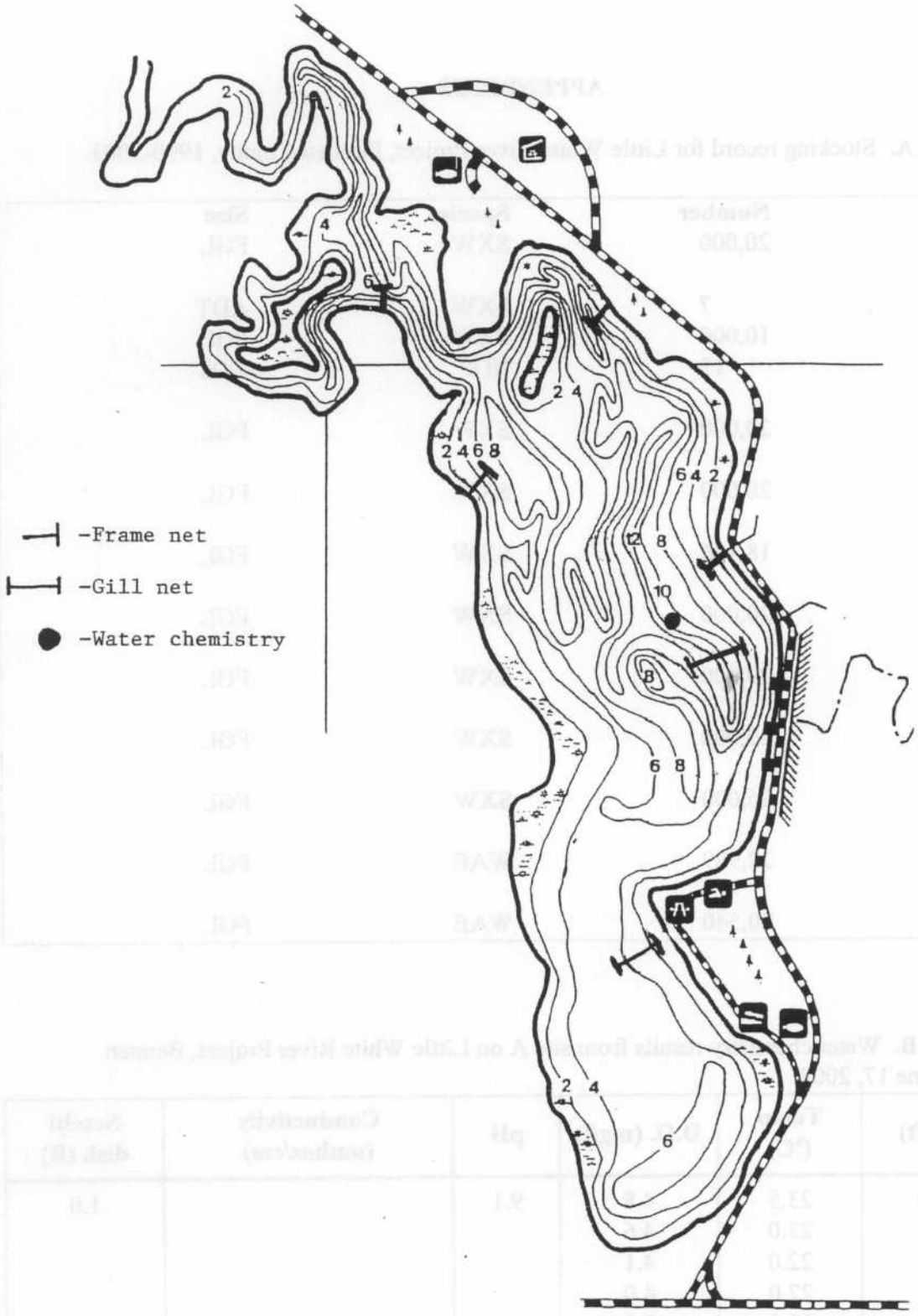
APPENDICES

Appendix A. Stocking record for Little White River Project, Bennett County, 1990-2003.

Year	Number	Species	Size
1990	20,000	SXW	FGL
1991	7	SXW	ADT
	10,000	SXW	FGL
	12	NOP	ADT
1993	20,000	SXW	FGL
1994	20,000	SXW	FGL
1995	18,446	SXW	FGL
1996	20,000	SXW	FGL
1997	20,000	SXW	FGL
1998	20,000	SXW	FGL
2001	25,000	SXW	FGL
2002	22,989	WAE	FGL
2003	20,540	WAE	FGL

Appendix B. Water chemistry results from site A on Little White River Project, Bennett County, June 17, 2003.

Depth (ft)	Temp (°C)	D.O. (mg/l)	pH	Conductivity (umhos/cm)	Secchi disk (ft)
surface	23.5	4.8	9.1		1.0
2	23.0	4.6			
4	22.0	4.1			
6	22.0	4.0			
8	22.0	3.9			



Appendix C. Net locations on Little White River Project.

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-36

Name: Newell City Pond County: Butte
Legal description: Sec. 25, T 9N, R 5E
Location from nearest town: 1.5 mi. W of Newell, SD
Dates of present survey: May 22, 2003 and October 17, 2003
Dates last surveyed: October 26, 1998; October 15, 1997
Most recent lake management plan: F2 I -R-2 Date: N/A
Management classification: Warmwater semi-permanent
Contour mapped: NA

Primary Species: (game and forage)
1. Largemouth bass
2. Bluegill
3. Northern pike
4. Yellow perch

Secondary and other species:
1. Walleye
2. White sucker
3. Common carp
4. Shorthead redhorse

PHYSICAL CHARACTERISTICS

Surface Area: 20 acres; Watershed: 17,000 acres
Maximum depth: 27 feet; Mean depth: 12 feet
Lake elevation at survey (from known benchmark): full feet

1. Describe ownership of lake and adjacent lakeshore property:

Newell City Pond is 75% owned by the city of Newell with the remaining 25% under private ownership. Adjacent to the lake is the municipal golf course. Newell City Pond is a reserve water supply for this area.

2. Describe watershed condition and percentages of land use:

The Newell City Pond is adjacent to grass land and the Newell City municipal golf course.

3. Describe aquatic vegetative condition:

Submerged aquatic vegetation in Newell City Pond consists of coontail. Summer months are often characterized as having large amounts of vegetation in the shallow bays and inlets. Emergent vegetation consists of bulrush and cattail.

4. Describe pollution problems:

No pollution problems were identified during the 2003 survey.

5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:

No problems were noted in the 2003 survey. Newell City Pond does not have a boat ramp.

CHEMICAL DATA

1. Describe general water quality characteristics.
Field measurements included temperature and dissolved oxygen profile, surface pH, surface conductivity and transparency (Appendix B).

2. Thermocline: No

3. Secchi disc reading: l Oft.

4. Stations for water chemistry located on attached lake map: No

BIOLOGICAL DATA

Methods

A lake survey was conducted at Newell City Pond on May 21-22, 2003. Sampling consisted of one gill net and 4 trap net nights. All gill nets were monofilament experimental nets. Each net was 45.7 m (150-ft) long and 1.8 m (6-ft) deep with six 7.6 m (25-ft) panels of bar mesh sizes: 12.7 mm (0.5 in), 19.l mm (0.75 in), 25.4 mm (1.0 in), 31.8 mm (1.25 in), 38.1 mm (1.5 in), and 50.8 mm (2.0 in). Trap nets were set at four stations consisting of 4 trap net nights each. All trap nets were modified fyke-nets with a 1.3 X 1.5-m frame, 19.l mm (0.75 inch) mesh and a l.2- X 23-m (3.9- X 75.5-ft) lead. Collected fish were measured for total length (TL; mm) and weighed (g). In addition, scale samples for the first five fish per centimeter group were collected from selected fish per gear type for age and growth analysis. Scale samples were pressed onto acetate slides and viewed with a microfiche projector (40X) and the distance between scale annuli were recorded on paper strips. All data was entered into WinFin 2.95 (Francis 1999).

Night electrofishing was conducted at Newell City Pond on September 1, 2003. Electrofishing was conducted using a Smith-Root unit with pulsed-DC. Six, ten-minute stations were completed during the survey. All largemouth bass were collected, measured for total length (TL; mm) and weighed (g). In addition, scale samples were collected from up to 5 fish per centimeter group for age and growth analysis. All data was entered into WinFin 2.95.

Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch per unit effort (CPUE), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr) based on length categories. Abundance was expressed as the mean catch per unit effort (CPUE; mean number per net night or mean number per hour of electrofishing). Actual pedal time (time the electrofishing unit produced current) was recorded from the digital display on the Smith-Root control box and used to calculate electrofishing CPUE. Population structural characteristics were

expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr.

Results and Discussion

Newell City Pond is located 1/2 mile west of Newell, adjacent to the golf course. It's location near town should make this a popular fishery. The City Pond is full of small panfish in poor condition. Black crappie dominated the frame net catch making up 74% of the total number of fish caught. Black crappie Wr was 80 and yellow perch was 72 (Table 2). The largemouth bass population is also lacking, with low density and small size structure. This is the first time Newell City Pond has been sample with frame nets and gill nets so there will be no comparison to past surveys. Population parameters of the dominant game fish species in Newell City Pond are discussed individually below.

Table 1. Total catch (N), catch per net night (CPUE; 80% Cl's in parentheses), catch per net night of stock-length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD-P; 90% Cl's in parentheses), and condition factor (Wr for fish > stock length; 80%CI's) for all fish species collected from four 3/4 inch frame nets in Newell City Pond, Ma 22, 2003.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr > S
BLC	175	43.8(25.8)	43.5(26.2)	0(--)	0(--)	80.4(0.6)
BLG	31	7.8(5.6)	7.8(5.6)	71(--)	6(--)	92.9(0.9)
COC	1	0.3(0.4)	0.3(0.4)	--	--	99.4(-)
NOP	1	0.3(0.4)	0.3(0.4)	--	--	81.4(-)
SHR	1	0.3(0.4)	0.3(0.4)	--	--	91.3(-)
VMS	1	0.3(0.4)	0.3(0.4)	--	--	83.1(--)
YEP	26	6.5(3.9)	6.5(3.9)	0(--)	0(--)	72.4(0.5)
total	236					

Table 2. Total catch (N), catch per net night, catch per net night of stock length fish proportional stock densities (PSD, RSD-P; 90% Cl's in parentheses), and condition factor (Wr for fish > stock length; 80%CI's) for all fish species collected from a 150-ft experimental sinking ill nets in Newell City Pond, Ma 22, 2003

Species		CPUE	CPUE-S	PSD	RSD-P	Wr > S
BLC	9	9.0	8.0	0	0	77.9(1.8)
NOP	3	3.0	3.0	--	--	85.7(1.2)
YEP	3	3.0	3.0	--		70.0(1.7)
Total	15					

Table 3. Total catch (N), pedal time (seconds), catch per hour of electrofishing (CPUE), catch per hour of electrofishing of stock length and larger fish (CPUE-S), proportional stock densities (PSD, RSD; 90% confidence intervals are given in parentheses) and condition factor (Wr for fish > stock length; 80%CI's) for largemouth bass collected by electrofishing at Newell City Pond, 1998-2003.

Year	N	Pedal Time sec	CPUE	CPUE-S	PSD	RSD-P	Wr-!S
1998	188	na	**93.5(-)**	**17.0(-)**	**47(-)**	**18(-)**	104.5(-)
1999	69	na	39.4(-)	20.0(-)	34(10)	9(6)	104.8(-)
2003	29	3,600	29.0(9.0)	6.0(5.6)	17(3)	0(--)	107.l(7.1)

Black Crappie

Newell City Pond has the classic characteristics of an overpopulated black crappie population. Frame net CPUE was 43.8 (Table 1). No fish in this population have reached a quality size of 8 inches (Figure 1). Fish condition was extremely poor with a Wr for stock length and larger fish of 80.4 (Table 1). Growth was extremely slow as shown in Table 4.

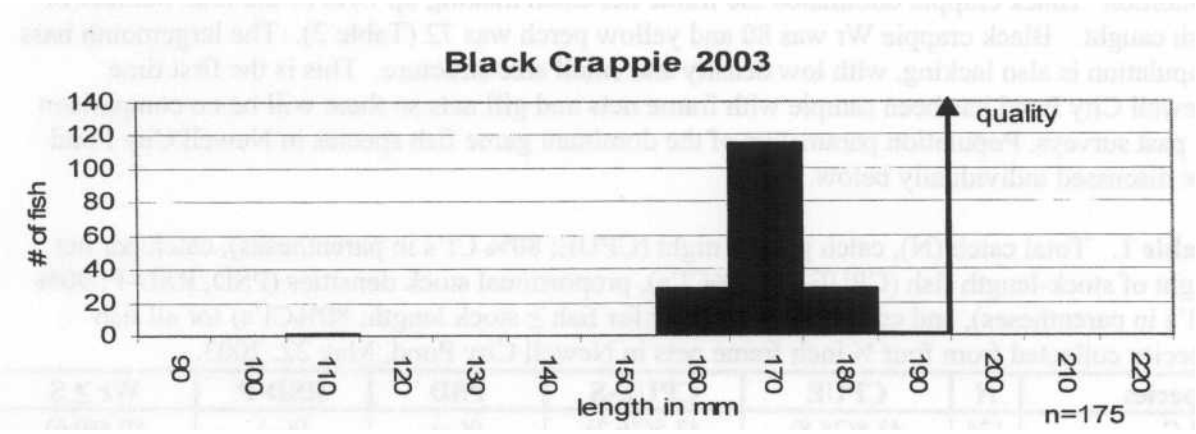


Figure 1. Length frequency histogram for black crappie sampled by frame nets in Newell City Pond, May 22, 2003.

Table 4. Newell City Pond black crappie year class, age in 2003, sample size (N), mean back-calculated total length at age, population standard error (SE), and the South Dakota black crappie mean length at age (Willis et al. 2001).

Year Class	Age	N	Age 1	2	3	4	5	6
2002	1	1	64					
2000	3	2	41	118	157			
1999	4	9	75	119	153	169		
1998	5	4	**68**	110	141	163	174	
1997	6	1	63	122	158	172	182	190
Sample size		17						
2003 Mean(SE)			**68(2)**	**117(3)**	**152(4)**	**168(2)**	**178(4)**	**190(0)**
South Dakota(SE)			83(2)	147(4)	195(5)	229(6)	249(6)	

Bluegill

The bluegill population is the only panfish species reaching a length useable by anglers. Frame net CPUE was 7.8. PSD was 71 and RSD-P was 6. Fish condition was average with a Wr for stock-length and larger fish of 92.9. Growth was only slightly slower than the statewide average (Table 5).

Table 5. Newell City Pond bluegill year class, age in 2003, sample size (N), mean back-calculated total length at age, population standard error (SE), and the South Dakota bluegill mean length at age (Willis et al. 2001).

Year Class	Age	N	Age 1	2	3	4	5
2002	1	2	52				
2001	2	1	40	88			
2000	3	1	63	100	123		
1999	4	14	43	84	121	150	
1998	5	1	58	100	144	162	174
Sample size		19					
2003 Mean(SE)			**51(4)**	**93(4)**	**129(7)**	**156(6)**	**174(0)**
South Dakota(SE)			55(2)	103(3)	141(3)	166(4)	180(4)

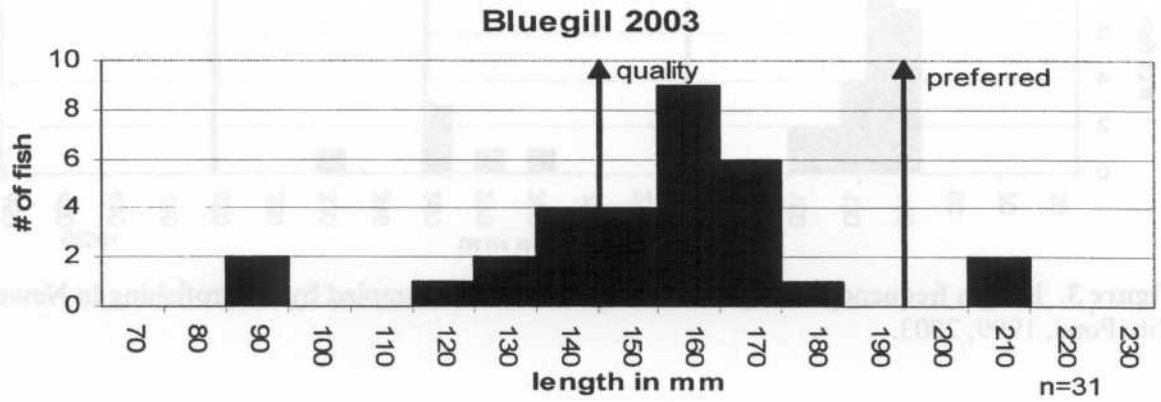


Figure 2. Length frequency histogram for black crappie sampled by frame nets in Newell City Pond, May 22, 2003.

Largemouth Bass

Newell City Pond's bass density is insufficient to control panfish at this time. CPUE for stock length and larger fish was 6.0 fish per hour which is lower than past surveys (Table 3). Black crappie numbers may be hurting bass recruitment. Wr for stock-length and larger fish was 107.1 (Table 3). Length frequency histograms show a population dominated by small fish especially when compared to 1999 (Figure 3). Age and growth data was not used due to small sample size.

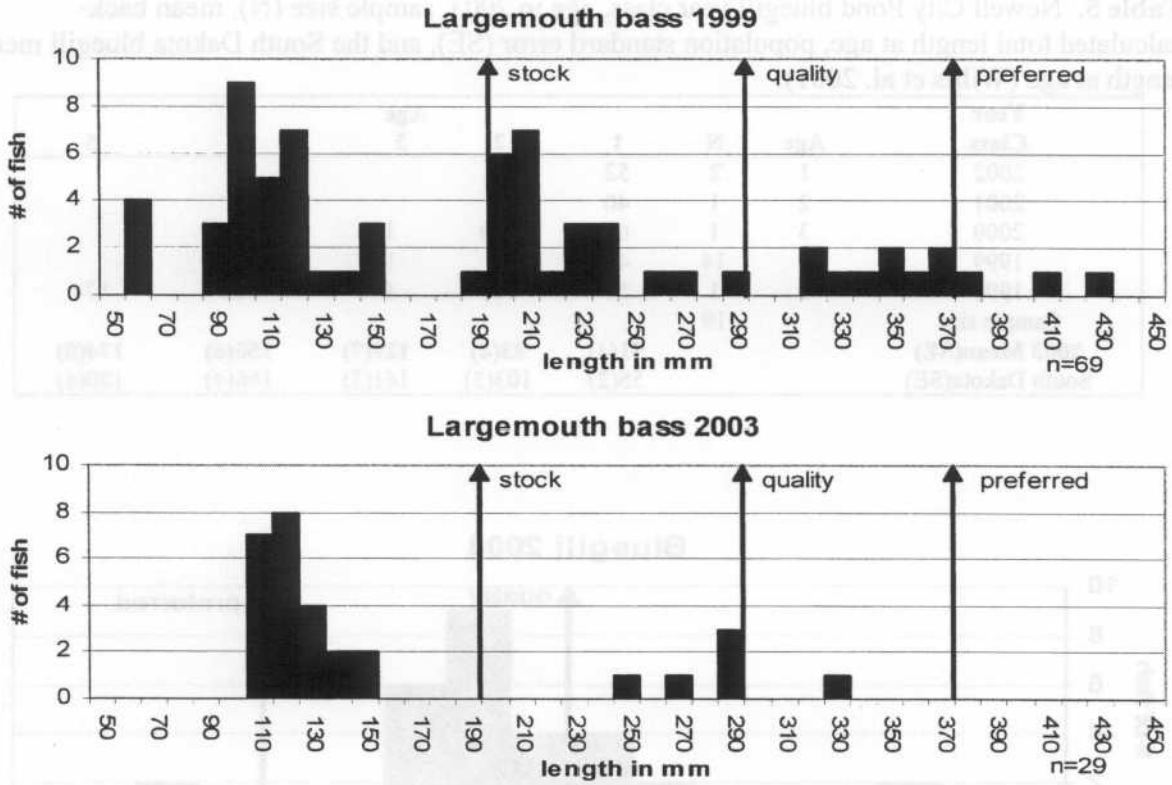


Figure 3. Length frequency histogram for largemouth bass sampled by electrofishing in Newell City Pond, 1999, 2003.

Yellow Perch

The perch population may be suffering the most by the overpopulation of black crappie. Wr for stock length and over for frame net sample was 72.4 (Table 1). Size structure was extremely poor with no fish sampled over quality length (Figure 4). Frame net CPUE was 6.5, and the gill net caught three (Table 1 &2). Growth was extremely poor, well below the state average (Table Al

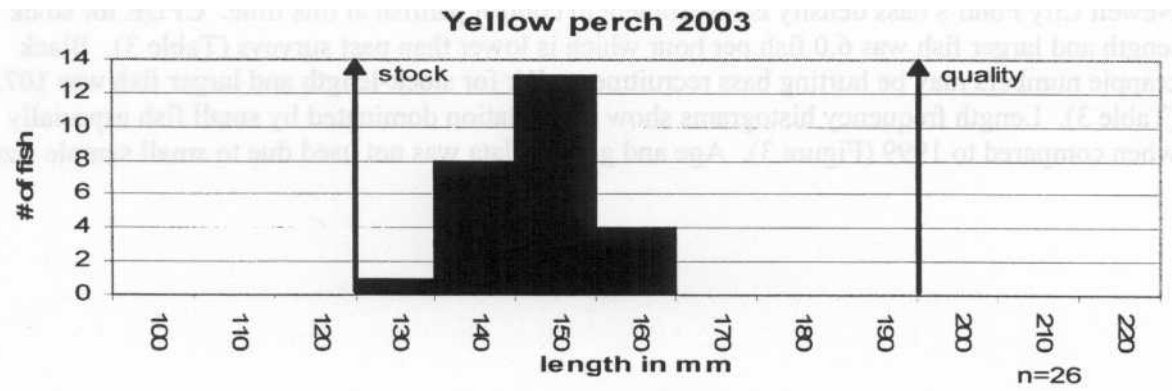


Figure 4. Length frequency histogram for yellow perch sampled by frame nets in Newell City Pond, May 22, 2003.

Table 6. Newell City Pond yellow perch year class, age in 2003, sample size (N), mean back-calculated total length at age, population standard error (SE), and the South Dakota yellow perc mean length at age (Willis et al. 2001).

Year Class	Age	N	Age 1	2	3	4	5
2001	2		77	127			
2000	3		71	118	138		
1999	4		76	113	132	146	
1998	5		77	112	126	144	152
Sample size							
2003 Mean(SE)			**75(2)**	**117(3)**	**132(4)**	**145(1)**	**152(0)**
South Dakota(SE)			86(2)	145(4)	190(5)	220(5)	242(8)

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RECOMMENDATIONS

1. Stock adult largemouth bass at a rate of 10 per acre to increase bass density, which should help thin out the black crappie population. Continue to monitor the largemouth bass population through fall electrofishing.

APPENDICES

Appendix A. Stocking record for Newell City Pond, Butte County, 1990-2003.

Year	Number	Species	Size
1990	2400	Rainbow trout	Catchable
1997	2000	Largemouth bass	Fingerling

Appendix B. Water chemistry results from on Newell City Pond, Butte County, May 30, 2003.

Depth (ft)	Temp (°C)	D.O. (mg/l)	pH	Conductivity (*u*mhos/cm)	Secchi disk (ft)
Surface	22.0	5.2		2000	10
2	22.0	5.2			
4	22.0	5.2			
6	22.0	5.2			
8	20.0	5.2			
10	20.0	5.2			
12	20.0	5.2			
14	20.0	5.2			
16	18.0	4.4			
18	17.0	3.6			
20	15.0	2.4			
22	14.0	1.4			
24	13.5	0.6			

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-36

Name: Newell Lake County: Butte
Legal description: T 10N, R 6E Sec. 9
Location from nearest town: 8 miles north and 2 miles east of Newell, SD
Dates of present survey: October 17, 2003
Date last surveyed: September 10, 2002
Most recent lake management plan: F21-R-30 Date: 1997
Management classification: Warmwater permanent
Contour mapped: Date 1991

Primary Species: (game and forage)	Secondary and other species:
1. Largemouth bass	1. Smallmouth bass
2. Bluegill	2. Walleye
3. Northern pike	3. White sucker
4. Yellow perch	4. Black bullhead
5. Rudd	

PHYSICAL CHARACTERISTICS

Surface Area: 183 acres, 74 ha; Watershed: 7680 acres
Maximum depth: 32 feet; Mean depth: 13.6 feet
Lake elevation at survey (from known benchmark): -4 feet

1. Describe ownership of lake and adjacent lakeshore property:

The Department of Game, Fish and Parks own Newell Lake, as well as the surrounding property. The shoreline is managed as a recreation area and a game production area.

2. Describe watershed condition and percentages of land use:

The Newell Lake watershed is approximately 12 square miles and is used primarily for livestock grazing.

3. Describe aquatic vegetative condition:

Submerged aquatic vegetation in Newell Lake consists of coontail and cattail. Summer months are often characterized as having large amounts of vegetation in the shallow bays and inlets. Emergent vegetation consists of bulrush and cattail.

4. Describe pollution problems:

No pollution problems were identified during the 2003 survey.

5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:

In 1998, following the lake survey, major damage occurred to the tubes that required rebuilding the spillway. Work on the spillway was completed in 1999. The spillway and dam is currently in good condition. At the time of the survey, low water made the boat ramp barely useable.

BIOLOGICAL DATA

Methods

Night electrofishing was conducted at Newell on October 17, 2003, using a Smith-Root unit with pulsed-DC. Six, ten-minute sights were completed during the survey. Largemouth bass were collected, measured for total length (TL; mm) and weighed (g). In addition, scale samples were collected from up to 5 fish per centimeter group for largemouth bass for age and growth analysis. All data was entered into WinFin 2.95 (Francis 1999).

Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch per unit effort (CPUE), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr) based on length categories. Abundance was expressed as the mean catch per unit effort (CPUE; mean number per net night or mean number per hour of electrofishing). Actual pedal time (time the electrofishing unit produced current) was recorded from the digital display on the control box and used to calculate electrofishing CPUE. Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr.

Largemouth Bass

Newell's bass population is improving in both quantity and quality. CPUE for stock-length and greater fish increased from 19.2 in 2002 to 41.0 in 2003 (Table 1). The increase in stock to quality length fish caused a drop in the PSD value in 2003 to 27, as compared to 50 in 2002. An increase in numbers of fish captured that were over quality length, however, caused RSD-P to increase from 0 in 2002 to 15 in 2003 (Table 2). Growth was excellent with back calculated lengths over the state average (Table 2). This is probably due to the abundant forage found in Newell. It was also no surprise that fish condition was also excellent with mean Wr values for stock-length and larger fish of 106.7 (Table 1). Even with two large year classes back to back, fish condition stayed above 100 throughout all length groups (Figure 2). Fish condition increased as fish length increased (Figure 2). A 12 to 16 inch slot with a one over 16 inch regulation is in place for 2004 to increase the numbers of larger bass. In addition to the slot length regulation, a 14-inch minimum was put on Newell Lake for walleye. It will be interesting to see how the increase in predator density affects the large bluegill and European rudd populations.

Table 1. Total catch (N), pedal time (seconds), catch per hour of electrofishing (CPUE), mean total length (TL, standard error is given in parentheses), proportional stock densities (PSD, RSD; 90% confidence intervals are given in parentheses) and condition factor (Wr for fish ≥ stock length; 80%CI's) for largemouth bass collected by electrofishing in Newell Lake, 1999-2003.

Year	N	Pedal Time (sec)	CPUE	CPUE-S	PSD	RSD-P	Wr≥S
1999	29	-----	14.5	9.0	67(15)	27(14)	--
2000	3	4,116	2.6	2.6	--	--	--
2002	125	7,200	82.2(28)	19.2(7)	50(16)	0	114.6(1.3)
2003	77	3,600	77.0(23)	41.0(14)	27(12)	15(10)	106.7(1.3)

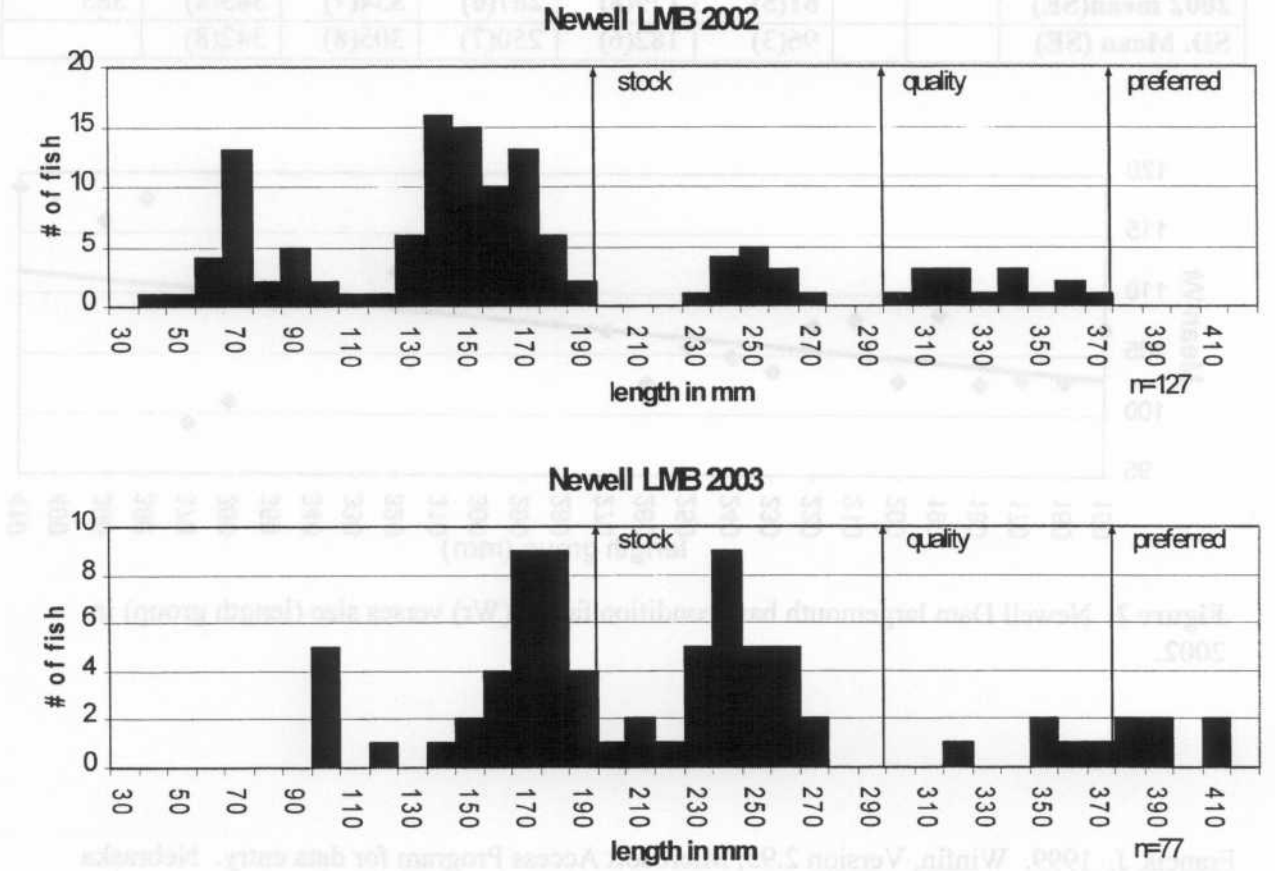

Figure 1. Length frequency histogram of largemouth bass collected by electrofishing in Newell Dam, 2002-2003.

Table 2. Newell largemouth bass year class, age in 2003, sample size (N), mean back-calculated total length at age, population standard error (SE), and the South Dakota bluegill mean length at age (Willis et al. 2001).

Year Class	Age	N	1	Age 2	3	4	5	6
2002	1	21	76					
2001	2	25	78	164				
2000	3	3	103	209	284			
1999	4	2	82	172	271	347		
1998	5	3	74	169	257	329	370	
1997	6	2	71	178	258	325	361	383
Sample Size		56						
2002 mean(SE)			**81(5)**	**179(8)**	**267(6)**	**334(7)**	**365(4)**	**383**
SD. Mean (SE)			96(3)	182(6)	250(7)	305(8)	342(8)	

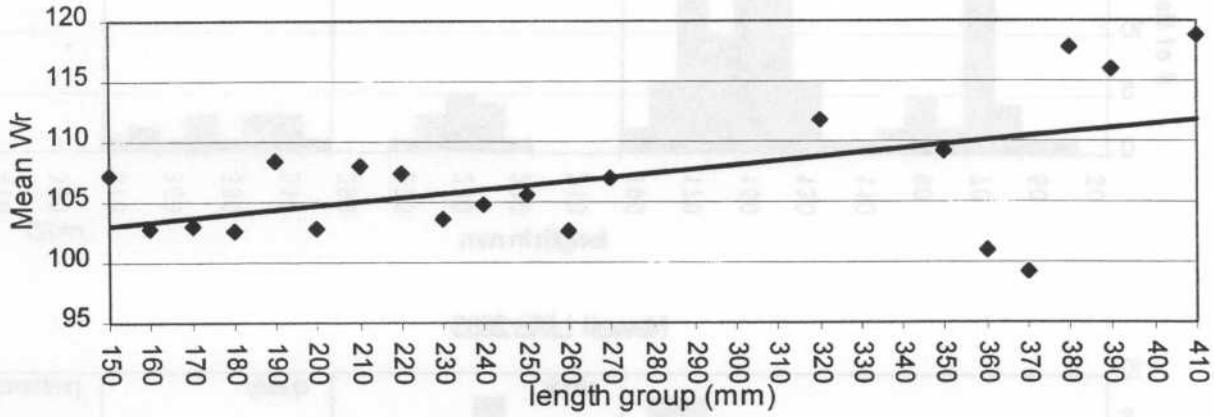

Figure 2. Newell Dam largemouth bass condition factor (Wr) verses size (length group) in 2002.

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RECOMMENDATIONS.

A. Stock advanced walleye fingerlings biannually as a secondary predator.

B. Since this is a small reservoir close to high numbers of anglers, largemouth bass should be surveyed annually to monitor population changes from angling and new regulations. Standard lake surveys should be done at least once every three years to check other fish populations.

APPENDICES

Appendix A. Stocking record for Newell Lake, Butte County, 1992-2003.

Year	Number	Species	Size
1992	13,600	Largemouth bass	Fingerling
	16,000	Saugeye	Fingerling
1993	17,000	Smallmouth bass	Fingerling
	17,000	Saugeye	Fingerling
1994	27,000	Saugeye	Fingerling
1995	20,000	Saugeye	Fingerling
1996	17,000	Largemouth bass	Fingerling
1997	4,200	Saugeye	Large fingerling
	18,400	Largemouth bass	Fingerling
1998	1,800	Saugeye	Advanced fingerling
2000	25,000	Saugeye	Fingerling
2001	100	Largemouth bass	Adult
2002	11,800	Largemouth bass	Fingerling
2003	1,120	Walleye	Large fingerlings

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-36

Name: Orman Dam (Belle Fourche Res.) County: Butte
Legal description: T 9N, R 3E Sec. 1, 2, 3, 7, 11-14, 19, 23-26, 29
Location from nearest town: 9 miles east of Belle Fourche, SD
Dates of present survey: August 25-27, 2003
Date last surveyed: August 12-14; September 4, 2002
Most recent lake management plan: F21-R-30 Date: 1996
Management classification: Warmwater permanent
Contour mapped: Date 1985

Primary Species: (game and forage)	Secondary and other species:
1. Walleye	1. Yellow perch
2. Channel catfish	2. Smallmouth bass
3. White bass	3. Gizzard shad
4. Black crappie	4. Longnose sucker
5.	5. Spottail shiner
6.	6. Common carp
7.	7. Tiger muskie

PHYSICAL CHARACTERISTICS

Surface Area: 8063 acres; Watershed: 2,867,200 acres
Maximum depth: 55 feet; Mean depth: 25 feet
Lake elevation at survey (from known benchmark): unknown

1. Describe ownership of lake and adjacent lakeshore property:

The U.S. Bureau of Reclamation (BOR) and the Belle Fourche Irrigation District performs the operation and maintenance of Orman Dam. The South Dakota Department of Game, Fish and Parks, Division of Wildlife manages 164 acres below the dam grade and the Division of Parks manages 350 acres around the boat ramp (T9N R3E, Sec. 24, 25). The U.S. BOR manages 6,617 acres around Orman Dam as wildlife habitat and for public access; although, irrigation has priority for water rights.

2. Describe watershed condition and percentages of land use:

The Orman Dam watershed is approximately 4,480 square miles consisting mostly of private land used for livestock grazing.

3. Describe aquatic vegetative condition:

Orman was very low during this survey, with hardly any vegetation being found in the entire lake.

4. Describe pollution problems:

Departmental personnel during the 2003 survey identified no pollution problems.

5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:

All structures appear to be in excellent condition. Repairs were performed on the outlets to reduce the amount of seepage from the reservoir. Low water made the boat ramp almost unusable.

CHEMICAL DATA

1. Describe general water quality characteristics.

No water chemistry data was done on Orman this year.

BIOLOGICAL DATA

Methods

Age-0 fish were collected with a 6.4-mm (1/4-in) mesh bag seine, measuring 30.5-m (100-ft) long and 1.8-m (6-ft) deep. All seining was conducted on July 16, 2003 at 4 established stations. Within each sampling station, 2 seine hauls were made. Each seine haul covered 0.2 acres for a total of 1.6 acres lake wide. All fish collected were identified, counted, and classified as "age-0" or "other".

A lake survey was conducted on Orman Reservoir August 25-27, 2003. Sampling consisted of 2 gill net nights and 8 trap net nights (Appendix C). Gill nets were generally set where it was deemed the most walleye would be collected (shallow flat areas). All gill nets were monofilament experimental nets. Each net was 91.4-m (300-ft) long and 1.8-m (6-ft) deep with six 15.2-m (50-ft) panels of bar mesh sizes: 12.7-mm (1/2-in), 19.1-mm (3/4-in), 25.4-mm (1-in), 31.8-mm (1 '/4-in), 38.1-mm (1 %2-in), and 50.8-mm (2-in). Trap nets were set at four stations consisting of 4 trap net nights each. All trap nets were modified fyke-nets with a 1.3-X 1.5-m frame, 19.1-mm ($^{3}/4$-in) mesh and a 1.2- X 23-m (3.9- X 75.5-ft) lead. Collected fish were measured for total length (TL; mm) and weighed (g). In addition, scale samples for the first five fish per centimeter group were collected from selected fish per gear type for age and growth analysis. Scale samples were pressed onto acetate slides and viewed with a microfiche projector

(40X) and the distance between scale annuli were recorded on paper strips. All data was entered into WinFin 2.95 (Francis 1999).

No night electrofishing was conducted at Orman Reservoir because of extremely low water levels. Most sites were out of water making data comparison unreliable.

Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch-per-unit-effort (CPUE), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr) based on length categories. Abundance was expressed as the mean catch-per-unit-effort (CPUE; mean number per net night). Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr.

Results and Discussion

Age-0 Fish Survey

1/4 Arch Seining

A total of 991, age-0 fish (9 species) were collected during seining (Table 1). Yellow perch were by far the most abundant young of the year species sampled, comprising 64% (N=63 1) of the total young of year sample. Forty-four walleye young of the year were sampled. Twelve young of the year gizzard shad were caught indicating some reproduction had taken place. The only other species sampled in any numbers were young of the year common carp; 200 were sampled.

Table 1. Field form depicting total catch by station of 1/4 arc seine pulls, Orman Reservoir, July 16, 2003.

1/4 Arc Seine Field Form

Lake: Orman Reservoir
County:Butte River
Date:7-16-03
Collected By:Miller, Keeton, Galinat

Seine Measurements; Length:100 ft
Depth:6 ft
Mesh Size: 1/4 inch square

	Station 1		Station 2		Station 3		Station 4		TOTAL	
Spp.	**Age-0**	**1+**	**Age-0**	**1+**	**Age-0**	**1+**	**Age-0**	**1+**	**Age-0**	**1+**
BLC	2								**2**	
CAP	62		67		4		67		**200**	
EMS			2						**2**	
GZD							12		**12**	
SPS	46	7	2		1		27		**76**	7
WAE	1				1		42		**44**	
WHB							1		**1**	
WHS	7		12		4				**23**	
YEP	7		2				622		**631**	
Total									**991**	7

Fish Community Survey

Gill and Trap Net Catch

Eleven species were collected in both gill nets and trap nets during the 2003 lake survey of Orman Reservoir. Ten species, totaling 515 fish, were collected in experimental gill nets (Table 2). Walleye dominated the catch, comprising 62.0% of the total. Gizzard shad were the second most common at 27%. Other species collected were channel catfish, common carp, river carpsucker, shorthead redhorse, spottail shiner, white bass and yellow perch (Table 2).

Nine species, totaling 169 fish, were collected in eight trap nets during the 2003 survey. Substock length white bass (45%) were the most numerous fish collected (Table 3). Black crappie (26%) were the second most common fish collected. Walleye were the third most abundant at 15%. Other species sampled include channel catfish, common carp, river carpsucker, shorthead redhorse, smallmouth bass and yellow perch (Table 3). Dominant species will be discussed individually below.

Night electrofishing catch

Extremely low water levels left our standard electrofishing sites out of the water. No electrofishing was completed because of low water.

Table 2. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD; 90% CI's in parentheses), and fish condition for fish larger than stock length (Wr>S; 90% CI's in parentheses) for all fish species collected from two, 300-ft experimental sinking gill nets in Orman Reservoir, August 25-27, 2003.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr>S
Black crappie	1	0.5(1.5)	0.5(1.5)	--	--	101.8(--)
Channel catfish	22	11.0(12.3)	6.5(7.7)	46(26)	8(13)	82.1(4.5)
Common carp	4	2.0(0.0)	2.0(0.0)	--	--	--
Gizzard shad	138	69.0(67.7)	4.0(9.2)	100(--)	--	109.0(3.9)
River carpsucker	3	1.5(1.5)	1.5(1.5)	--	--	--
Shorthead redhorse	2	1.0(3.1)	1.0(3.1)	--	--	--
Spottail shiner	2	1.0(3.1)	1.0(3.1)	--	--	--
Walleye	317	158.5(297.0)	125(255.5)	29(5)	1(1)	85.6(0.1)
White bass	9	4.5(10.8)	1.0(3.1)	100(--)	50(50)	101.8(27.2)
Yellow perch	17	8.5(13.9)	3.5(1.5)	86(28)	14(28)	82.0(5.1)
Totals	515					

Table 3. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD; 90% CI's in parentheses) and fish condition for fish larger than stock length (Wr>S; 90% CI's in parentheses) for all fish species collected from 8 modified-fyke trap nets in Orman Reservoir, August 25-27, 2003.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr>S
Black crappie	44	5.5(4.8)	5.5(4.8)	100(--)	93(6)	105.2(0.5)
Channel catfish	1	0.1(0.2)	0.1(0.2)	--	--	--
Common carp	1	0.1(0.2)	0.1(0.2)	--	--	--
River carpsucker	3	0.4(0.4)	0.4(0.4)	--	--	--
Shorthead redhorse	10	1.3(0.7)	1.3(0.7)	--	--	--
Smallmouth bass	5	0.6(0.5)	0.6(0.5)	--	--	95.7(17.9)
Walleye	25	3.1(1.9)	2.4(1.6)	37(20)	11(12)	--
White bass	76	9.5(8.7)	0.0(--)	0(--)	0(--)	--
Yellow perch	4	0.5(0.5)	0.5(0.5)	--	--	--
Totals	169					

Black crappies

Black crappies were the most numerous species collected in trap nets, but were still relatively low in abundance with a CPUE of 5.5. Low water made finding suitable trap net sites hard, and may have affected catch rates. The forty-four fish sample yielded a PSD of 100 with an RSD-P of 93. Fish condition was excellent with a mean Wr for stock length and larger fish of 105.2. Last year CPUE was 2.5 with a PSD of 95 and an RSD-P of 23.

Table 4. Composite listing of sample size (N), catch per net night (CPUE; 80% CI's in parentheses), and proportional stock densities (PSD, RSD; 90% CI's in parentheses) for black crappie from Orman Reservoir, 2000-2003.

Year	N	CPUE	PSD	RSD-P
2000	81	8.2(6.9)	44(10)	33(10)
2001	47	5.9(3.0)	87(8)	9(7)
2002	22	2.8(1.9)	95(7)	23(16)
2003	44	5.5(4.8)	100(--)	93(7)

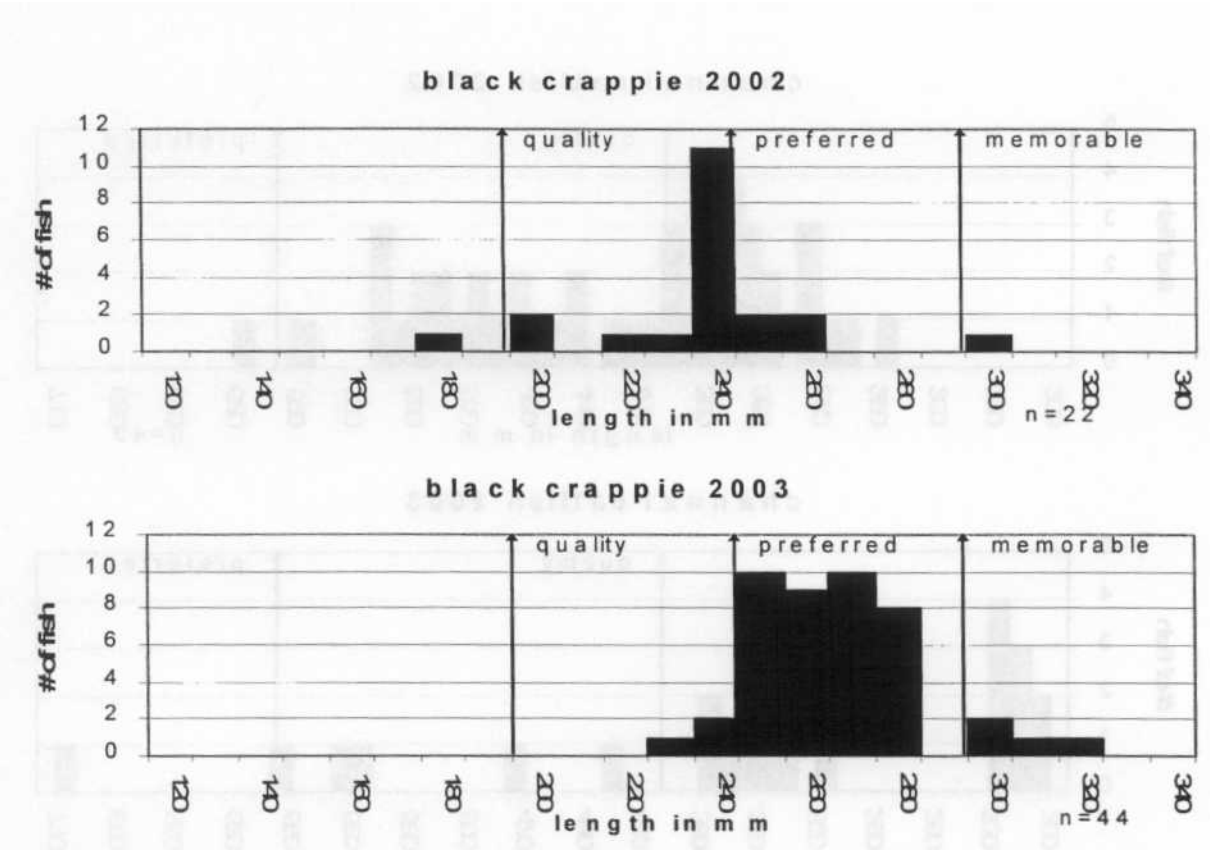

Figure 1. Length histogram of black crappies collected in trap nets from Orman Reservoir, Butte County, 2002-2003.

Channel Catfish

Channel catfish were the third most abundant species in the gill net sample with a CPUE of 11.0; down from 22.5 last year (Table 5). Stock indices were similar to years past with a PSD of 51 and an RSD-P of 2. It is surprising that RSD-P never rises, as the creel survey showed very little harvest of channel catfish. Fish condition was low with a mean Wr for stock length and larger catfish of 82.1 (Table 2). Fish ranged in size from 200-mm to 710-mm (Figure 2).

Table 5. Composite listing of sample size (N), catch per gillnet night (CPUE; 80% CI's in parentheses), and proportional stock densities (PSD, RSD; 90% CI's in parentheses) for channel catfish from Orman Reservoir, 1999-2003.

Year	N	CPUE	PSD	RSD-P
1999	34	5.7(2.0)	78(12)	0(na)
2000	54	13.5(9.9)	69(12)	2(4)
2001	107	26.8(10.3)	56(8)	3(3)
2002	45	22.5(41.6)	51(2)	2(4)
2003	22	11.0(12.3)	46(26)	8(13)

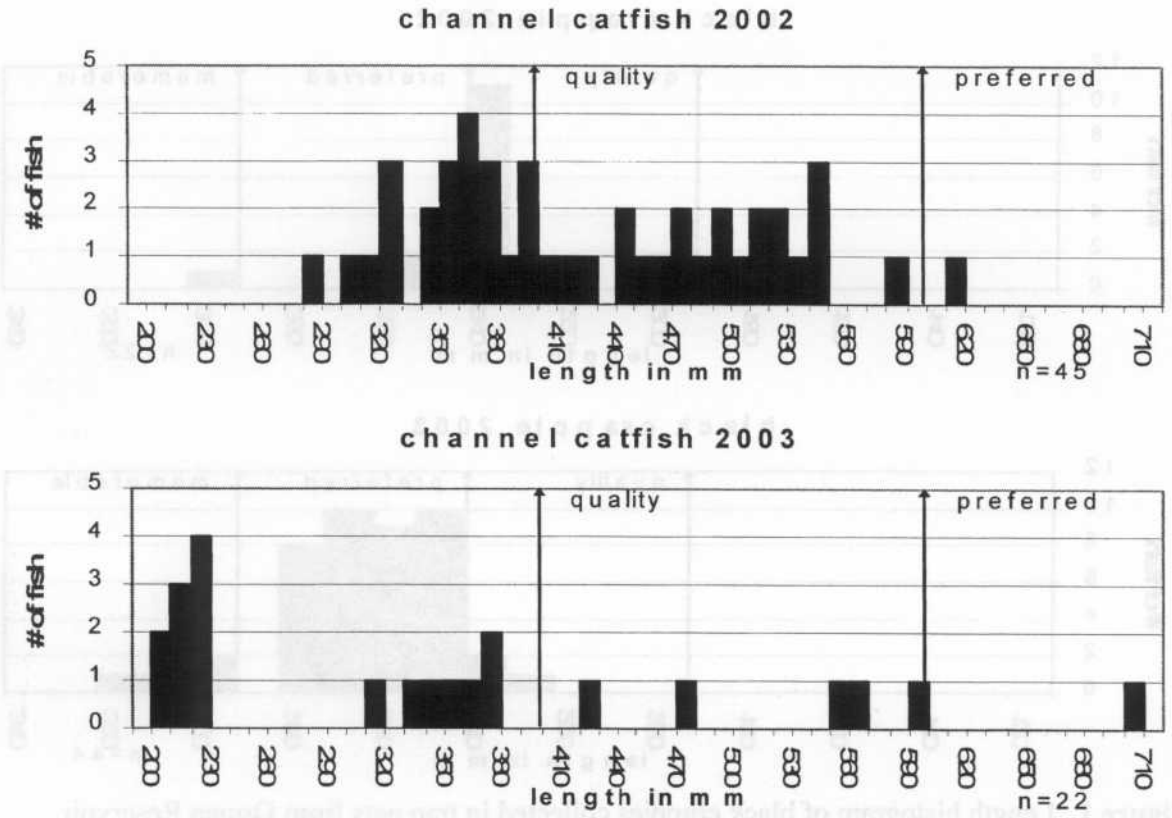

Figure 2. Length histogram of channel catfish collected in gillnets from Orman Reservoir, Butte County 2002-2003.

Gizzard Shad

Gizzard Shad are thought to be the driving force behind the thriving walleye population. Since their introduction, walleye growth rates have improved dramatically. Quarter arc seining is done annually to check for gizzard shad reproduction. This year's numbers were low with a total catch of 12 young-of-year shad, compared to 3,942 last year. While the seining showed less shad, the gill nets showed an increase in shad numbers. Last year three adult gizzard shad were sampled out of the two gill nets. Gill nets from this survey captured eight adult shad and 130 young-of-year (Figure 3). Adult shad stocking is done annually to insure adequate forage, in case of a total winterkill.

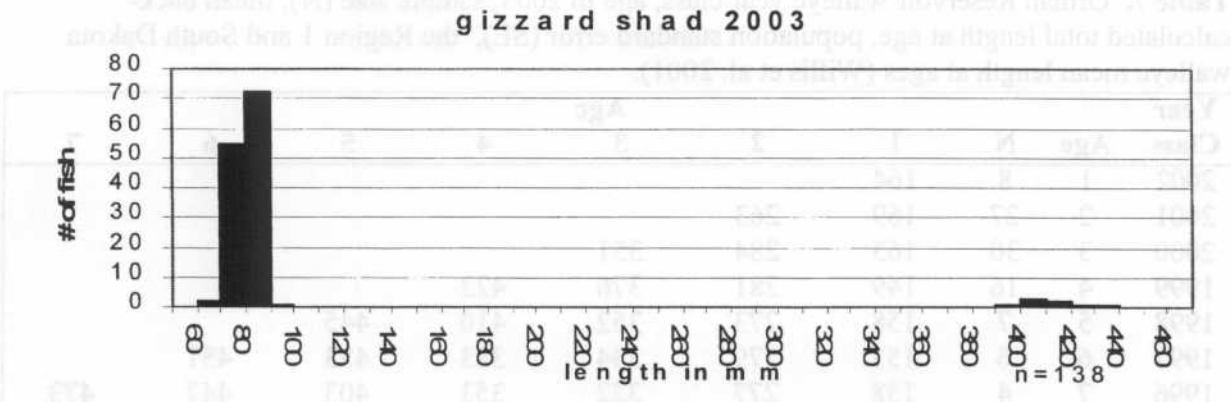

Figure 3. Length frequency histogram of gizzard shad from gillnets at Orman Reservoir, 2003.

Walleye

Walleye abundance continues to increase with a gill net CPUE of 158.5. For comparison, last year's CPUE was 89.0 (Table 6). Confidence intervals were high so statistically there was not a difference. Stock indicies were low with a PSD of 29 and an RSD-P of 1, which were similar to last year (Table 6). A one over 20-inch rule was added to the existing 14-inch minimum in hopes of increasing the RSD-P. It is doubtful this will have much effect as only one percent of the population is making it over 20 inches, but it should place a higher value on larger walleye. During seining, 44 young of the year walleye were sampled, and 63 were sampled in the gill nets. This appears to be one of the largest age-0 samples recorded in recent years (Figure 5).

Fish condition was average for Orman with two of the three length categories showing small increases (Table 8). Growth was slightly below the state average, but fish born in the last three years have shown an increase in growth rates (Table 7). This is probably due to the establishment of the gizzard shad as an effective forage base.

Table 6. Composite listing of sample size (N), catch per unit effort (CPUE; 80% confidence intervals are given in parentheses), catch per net night of stock length fish (CPUE-S; 80%CI's), and proportional stock densities (PSD, RSD; 90% Cl's are given in parentheses) for walleye collected by Pill net in Orman Reservoir, 1998-2003.

Year	N	CPUE	CPUE-S	PSD	RSD-P
1998	87	9.6		2	0
1999	133	22.2		21 (6)	0
2000	109	27.3 (17.6)	22.3 (11.1)	65 (9)	0 (na)
2001	283	70.8 (33.2)	63.8 (31.3)	47 (5)	4 (2)
2002	178	89.0(40.0)	87.5(41.6)	38(6)	3(2)
2003	317	158.5(297.0)	125.0(255.5)	29(5)	1(1)

Table 7. Orman Reservoir walleye year class, age in 2003, sample size (N), mean back-calculated total length at age, population standard error (SE), the Region 1 and South Dakota walleye mean length at ages (Willis et al. 2001).

Year Class	Age	N	Age 1	2	3	4	5	6	7
2002	1	8	164						
2001	2	27	169	263					
2000	3	30	163	284	351				
1999	4	16	149	281	376	422			
1998	5	7	158	273	352	410	445		
1997	6	6	153	279	334	383	433	457	
1996	7	4	138	277	322	353	403	447	473
Mean (SE)		**98**	**156(4)**	**276(3)**	**347(9)**	**392(15)**	**427(13)**	**452(5)**	**473(0)**
Region 1			164 (17)	260 (22)	332 (27)	385 (32)	444 (42)		
S.D. Mean			168 (3)	279 (6)	360 (7)	425 (8)	490 (9)		

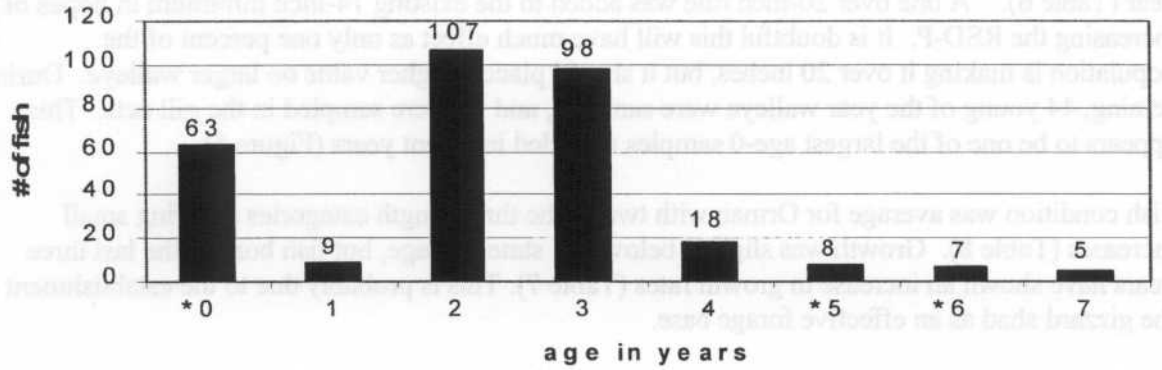

Figure 4. Age frequency histogram of walleye collected by gill net in Orman Reservoir, 2003. An "*" indicates years when walleye were stocked.

Table 8. Mean condition (Wr) for gillnet walleye of length categories on Orman 2000-2003.

Description	2000	2001	2002	2003
Substock	96.8(7.9)	95.5(1.0)	82.5(1.2)	84.6(2.8)
Stock to quality	84.4(1.0)	88.0(0.4)	87.3(0.2)	87.3(0.1)
Quality to preferred	83.8(0.4)	84.5(0.2)	80.4(0.4)	81.8(0.1)

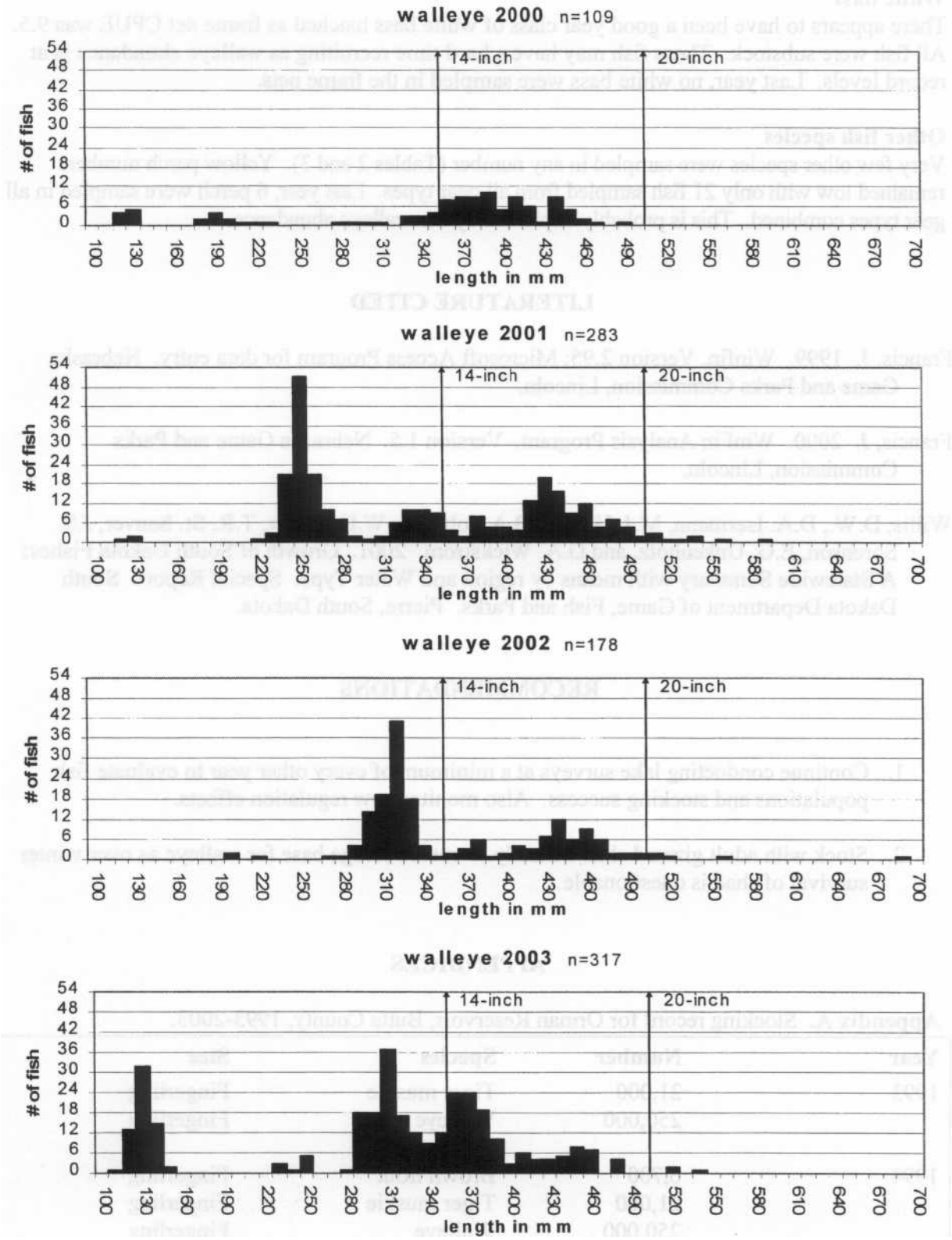

Figure 5. Length frequency histogram for gill net walleye from Orman Reservoir 1999-2003.

White bass

There appears to have been a good year class of white bass hatched as frame net CPUE was 9.5. All fish were substock. These fish may have a hard time recruiting as walleye abundance is at record levels. Last year, no white bass were sampled in the frame nets.

Other fish species

Very few other species were sampled in any number (Tables 2 and 3). Yellow perch numbers remained low with only 21 fish sampled from all gear types. Last year, 6 perch were sampled in all gear types combined. This is probably explained by the walleye abundance.

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Francis, J. 2000. WinFin Analysis Program. Version 1.5. Nebraska Game and Parks Commission, Lincoln.

Willis, D.W., D.A. Isermann, M.J. Hubers, B.A. Johnson, W.H. Miller, T.R. St. Sauver, J.S. Sorenson, E.G. Unkenholz, and G.A. Wickstrom. 2001. Growth of South Dakota Fishes: A Statewide Summary with means by region and Water Type. Special Report. South Dakota Department of Game, Fish and Parks. Pierre, South Dakota.

RECOMMENDATIONS

1. Continue conducting lake surveys at a minimum of every other year to evaluate fish populations and stocking success. Also monitor new regulation effects.

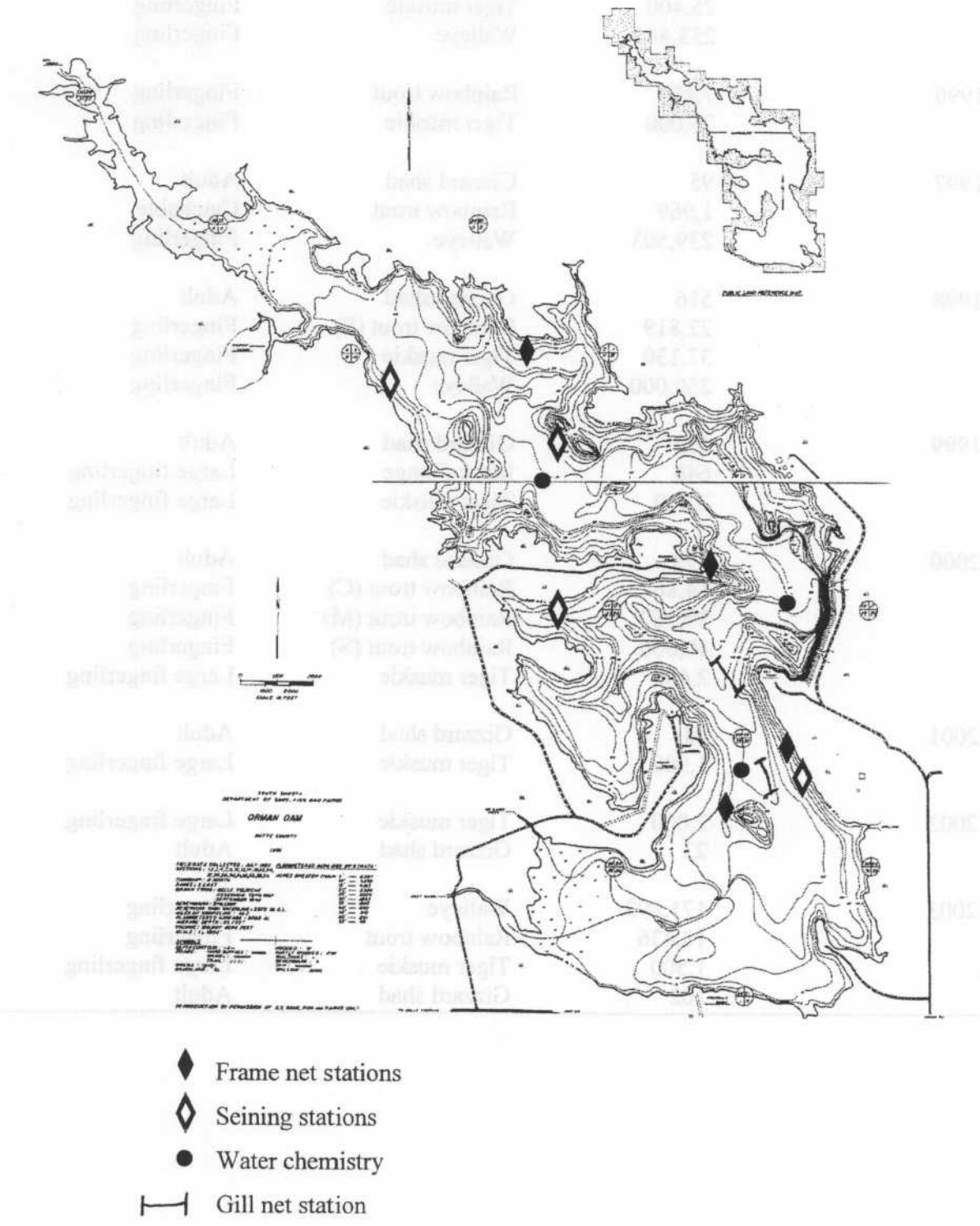
2. Stock with adult gizzard shad annually to ensure forage base for walleye as over winter survival of shad is questionable.

APPENDICES

Appendix A. Stocking record for Orman Reservoir, Butte County, 1993-2003.

Year	Number	Species	Size
1993	21,000	Tiger muskie	Fingerling
	250,000	Walleye	Fingerling
1994	6,700	Brown trout	Fingerling
	21,000	Tiger muskie	Fingerling
	250,000	Walleye	Fingerling

1995	5,500	Brown trout	Fingerling
	25,400	Tiger muskie	Fingerling
	253,440	Walleye	Fingerling
1996	7,414	Rainbow trout	Fingerling
	25,000	Tiger muskie	Fingerling
1997	95	Gizzard shad	Adult
	1,969	Rainbow trout	Catchable
	239,503	Walleye	Fingerling
1998	516	Gizzard shad	Adult
	22,819	Rainbow trout (S)	Fingerling
	37,130	Tiger muskie	Fingerling
	250,000	Walleye	Fingerling
1999	522	Gizzard shad	Adult
	640	Muskellunge	Large fingerling
	2,000	Tiger muskie	Large fingerling
2000	493	Gizzard shad	Adult
	14,867	Rainbow trout (C)	Fingerling
	39,162	Rainbow trout (M)	Fingerling
	40,000	Rainbow trout (S)	Fingerling
	2,600	Tiger muskie	Large fingerling
2001	48	Gizzard shad	Adult
	1,900	Tiger muskie	Large fingerling
2002	2,000	Tiger muskie	Large fingerling
	23	Gizzard shad	Adult
2003	171,893	Walleye	Fingerling
	18,436	Rainbow trout	Fingerling
	1,500	Tiger muskie	Large fingerling
	102	Gizzard shad	Adult



Appendix C. Locations of sampling site on Orman Dam, Butte County, 2002.

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-36

Name:Angostura Reservoir County:Fall River
Legal description:T 8S, R 5,6 E Sec. 1-12,17,19,20, 21, 28-33
Location from nearest town:7 miles southeast of Hot Springs, SD.
Dates of present survey:July 14, August 5-7, 2003;
Date last surveyed:August 5-8, 2002
Most recent lake management plan:F21-R-30 Date: 1997
Management classification:Warmwater permanent
Contour mapped: Date 1985

Primary Species: (game and forage)
1. Black Crappie
2. Channel catfish
3. Emerald Shiner
4. Gizzard shad
5. Largemouth bass
6. Smallmouth bass
7. Spottail shiner
8. Walleye

Secondary and other species:
1. Bluegill
2. Common carp
3. Green sunfish
4. Northern pike
5. Northern redhorse
6. River carpsucker
7. White sucker
8. Yellow perch

PHYSICAL CHARACTERISTICS

Surface Area:4,612 acres; Watershed:5,824,000 acres
Maximum depth:70 feet; Mean depth:29.3 feet
Lake elevation at survey (from known benchmark): unknown

1. Describe ownership of lake and adjacent lakeshore property:

The U.S. Bureau of Reclamation performs the maintenance of Angostura Reservoir and Dam. The South Dakota Department of Game, Fish and Parks manages much of the adjacent land as a recreation/campground area and game production area. The local irrigation district controls the water level and irrigation releases.

2. Describe watershed condition and percentages of land use:

The Angostura Reservoir watershed consists of approximately 9,100 square miles of livestock pastureland. Ownership of the watershed is predominately private with a small portion in Buffalo Gap National Grassland.

3. Describe aquatic vegetative condition:

Little precipitation throughout 2003 along with heavy irrigation left Angostura with low water levels. Emergent vegetation was left high and dry. Submergent vegetation consisted of Curlyleaf pondweed, *Potamogeton crispus,* an undesirable exotic that was observed in the bays of Angostura, in the 2003 lake survey.

4. Describe pollution problems:

Department personnel identified no pollution problems during the 2003 survey.

5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:

No apparent problems were identified on either the dam or spillway. Most of the boat ramps and other facilities were in good condition.

CHEMICAL DATA

1. Describe general water quality characteristics.

Water chemistry parameters were collected on August 13, 2003 at 3 established stations (Figure 2). Field measurements included temperature and dissolved oxygen, conductivity and pH profile, and transparency (Appendix A). Water samples were collected from the surface using 2 liter sampling bottles and sent to the laboratory for total phosphorus and chlorophyll A analysis. No obvious problems were identified from the results of this testing. Secchi depth, chlorophyll A, and total phosphorous values were combined for all three sites and mean values were used to calculate the Trophic State Index (TSI) (Carlson 1977) of Angostura Reservoir. The TSI ranking is from 1 to 100. Lakes with low TSI values (<40) are considered oligotrophic, 40 to 50 are mesotrophic, while those with higher values (>50) indicate eutrophic conditions. The TSI values categorize Angostura Reservoir as eutrophic (Table 1). The TSI trend for Angostura is shown in Table 1.

2. Thermocline:No;

3. Secchi disc reading:Station I = 1.1 m; Station 2= 1.4m; Station 3= 1.1 m mean= 1.2m

4. Stations for water chemistry located on attached lake map: Yes

Station 1=Dam grade
Station 2=Horsehead Creek
Station 3=Cheyenne River

Table 1. Trophic State Indices (TSI) of Angostura Reservoir 1992-2003. Indices include secchi depth (SD), chlorophyll A (Chl A), total phosphorus (TP) and mean TSI.

TSI Values	1992	1993	1995	1996	1997	1998	2000	2001	2003
SD	42	27	57	51	55	51	53	57	57
Chl A	27	39	42	52	45	--	40		
TP	55	50	57	62	37	47	44	52	54
Mean TSI	42	38	52	55	46	49	46	55	56

BIOLOGICAL DATA

Methods

Age-0 fish were collected with a 6.4 mm (1/4 inch) mesh bag seine, measuring 30.5 m (100 ft) long and 1.8 m (6 ft) deep. All seining was conducted on July 14 at 4 established stations (Figure 2). Within each sampling station, 2 seine hauls were made. Each seine haul covered 0.2 acres for a total of 1.6 acres sampled. All fish collected were identified, counted, and classified as age-0 or "other".

A lake survey was conducted on Angostura Reservoir August 5-7, 2003. Sampling consisted of 4 gill net nights and 11 trap net nights (Appendix C). Gill nets were generally set where it was deemed the most walleye would be collected (shallow flat areas). One gill net was set deep to sample for possible cold water species. All gill nets were monofilament experimental nets. Each net was 91.4-m (300-ft) long and 1.8-m (6-ft) deep with six 15.2-m (50-ft) panels of bar mesh sizes: 12.7-mm ('/2-in), 19.1-mm (^{3}/4-in), 25.4-mm (1-in), 31.8-mm (1'/4-in), 3 8.1-mm (1'/2-in), and 50.8-mm (2-in). Trap nets were set at three stations consisting of 4 trap net nights each. One trap net did not fish and was not counted in the data. All trap nets were modified fyke-nets with a 1.3-X 1.5-m frame, 19.1-mm (^{3}/4-inch) mesh and a 1.2- X 23-m (3.9- X 75.5-ft) lead. Collected fish were measured for total length (TL; mm) and weighed (g). In addition, scale samples for the first five fish per centimeter group were collected from selected fish per gear type for age and growth analysis. Scale samples were pressed onto acetate slides and viewed with a microfiche projector (40X) and the distance between scale annuli were recorded on paper strips. All data was entered into WinFin 2.95 (Francis 1999).

Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch-per-unit-effort (CPUE), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr). Abundance was expressed as the mean catch-per-unit-effort (CPUE; mean number per net night. Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr.

Results and Discussion

Age-0 Fish Survey

14 Arch Seining

A total of 7,604 age-0 fish (9 species) were collected during seining (Table 2). Gizzard shad were the most common age-0 fish (N=7,497). That comprises 98.6% of the total young of the

year sampled. The occurrence of age-0 gizzard shad is encouraging, last year only 20 were sampled. Different water levels and site locations make comparing seining data from year to year unreliable.

Table 2. Field form depicting total catch by station of 1/4 arc seine pulls, Angostura Reservoir, July 14, 2003.

1/4 Arc Seine Field Form

Lake: Angostura Reservoir
County: Fall River
Date: 7-14-2003
Collected By: Miller, Keeton, James

Seine Measurements; Length: 100 ft
Depth: 6 ft
Mesh Size: 1/4 inch square

	Station 1		Station 2		Station 3		Station 4		TOTAL	
Spp.	**yoy**	**1+**	**yoy**	**1+**	**yoy**	**1+**	**yoy**	**1+**	**yoy**	**1+**
BLC			3		5				**8**	
BLG		1	1		1	1			**2**	**2**
CAP			25				10	5	**35**	**5**
CCF		2		3						**5**
EMS	9	23	1	10	6	1		14	**16**	**48**
FRD				5		2				**7**
GZD	560	1	322		801		1		**1684**	**1**
GSF					1				**1**	
LMB	1	1		1	4				**5**	**2**
RIC				1						**1**
SHR								4		**4**
SMB	3	3	5		6		18	7	**32**	**10**
SPS	22		14	11					**36**	**11**
WAE		1	27	1	26				**53**	**2**
WHS			1		1				**2**	
YEP			54		20		1		**75**	
Total	595	32	453	32	871	4	30	30	**1949**	**98**

Fish Community Survey

Gill and Trap Net Catch

Fourteen species were collected in both gill nets and trap nets during the 2002 lake survey of Angostura Reservoir. Ten species, totaling 521 fish, were collected in four experimental gill nets (Table 3). Channel catfish were the most common species collected with walleye being the second most common. Other species collected were common carp, freshwater drum, gizzard shad, northern pike, river carpsucker, shorthead redhorse, smallmouth bass and yellow perch.

Thirteen species, totaling 355 fish, were collected in trap nets during the 2003 survey. Channel catfish were the most common fish collected and bluegill the second most common (Table 4). Other species collected were black crappie, channel catfish, common carp, freshwater drum, green sunfish, largemouth bass, northern pike, river carpsucker, shorthead redhorse, walleye and yellow perch.

Night electrofishing Catch

Extremely low water levels left our electrofishing sites high and dry, so no electrofishing was done in 2003.

Table 3. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock-length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD; 90% CI's in parentheses), and fish condition for fish larger than stock-length (Wr>S; 90% CI's in parentheses) for all fish species collected from four 300-ft experimental sinking gill nets in Angostura Reservoir, Fall River County, August 5-7, 2003.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr>S
Black crappie	2	0.5(0.8)	0.5(0.8)	--	--	92.4(9.7)
Channel catfish	233	58.3(26.4)	16.5(6.0)	8(6)	0(-)	85.5(1.0)
Common carp	36	9.0(4.6)	9.0(4.6)	19(12)	0(-)	79.9(0.9)
Freshwater drum	24	6.0(4.1)	3.8(2.4)	7(11)	0(-)	90.3(1.4)
Gizzard shad	13	3.3(2.4)	1.5(1.6)	100(-)	--	104.1(4.5)
River carpsucker	25	6.3(6.4)	6.3(6.4)	96(7)	96(7)	91.0(1.5)
Shorthead redhorse	20	5.0(4.9)	5.0(4.9)	100(-)	20(16)	81.2(0.9)
Smallmouth bass	39	9.8(12.0)	8.8(11.3)	40(14)	20(12)	98.3(1.5)
Walleye	117	29.3(26.2)	23.3(19.7)	32(8)	2(3)	84.6(0.2)
Yellow perch	12	3.0(4.9)	2.3(3.7)	11(21)	0(-)	85.3(3.0)
Totals	521					

Table 4. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock-length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD; 90% CI's in parentheses) and fish condition for fish larger than stock-length (Wr>S; 90% CI's in parentheses) for all fish species collected from 11 modified-fyke trap nets in Angostura Reservoir, Fall River County, August 5-7, 2003.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr>S
Black crappie	30	2.7(0.9)	2.0(0.7)	55(19)	14(13)	105.0(2.3)
Bluegill	103	9.4(5.2)	9.4(5.2)	39(8)	0(-)	100.9(0.2)
Channel catfish	137	12.5(3.9)	0.6(0.5)	17(33)	0(-)	--
Common carp	8	0.7(0.5)	0.6(0.5)	29(35)	0(-)	83.5(1.4)
Freshwater drum	12	1.1(0.7)	0.4(0.3)	25(59)	0(-)	87.3(6.9)
Green Sunfish	1	0.1(0.1)	0.1(0.1)	--	--	89.7(-)
Largemouth bass	1	0.1(0.1)	0.1(0.1)	--	--	111.4(-)
Northern pike	2	0.2(0.2)	0.2(0.2)	--	--	75.7(-)
River carpsucker	32	2.9(1.8)	2.9(1.8)	91(9)	78(13)	87.1(1.4)
Shorthead redhorse	11	1.0(0.6)	1.0(0.6)	73(25)	0(-)	79.9(1.0)
Smallmouth bass	3	0.3(0.2)	0.2(0.2)	--	--	101.4(-)
Walleye	12	1.1(0.5)	0.9(0.4)	60(30)	40(30)	81.5(4.7)
Yellow Perch	3	0.3(0.4)	0.3(0.4)	--	--	81.8(9.3)
Totals	355					

Black crappies

Abundance of black crappies remained low with numbers very similar to last year with a CPUE of 2.7 (Table 5). Stock density indices were also similar, with a PSD=55 and RSD-P=14 (Table 5). Mean condition of black crappies was good, with Wrs ranging from 99 to 109 (Table 6). The length frequency histogram shows crappie reproduction, but most fish seem to disappear before they recruit to the population (Figure 1).

Table 5. Composite listing of sample size (N), catch per unit effort (CPUE; 80% confidence intervals are given in parentheses), catch per unit effort of stock length fish (CPUE-S; 80% CI's are given in parentheses), and proportional stock densities (PSD, RSD; 90% CI's are given in parentheses) for black crappie collected by trap nets in Angostura Reservoir, 1993-2003.

Year	N	CPUE	CPUE-S	PSD	RSD-P
1993	608	50.7		2	1
1994	381	31.8		42	0
1995	117	9.8		78	0
1996	338	28.2		88	1
1997	340	34.0		94	10
1998	103	8.6		98	63
2000	146	*15.8 (7.0)		85 (5)	30 (6)
2001	22	1.8 (1.7)	1.6 (1.6)	79 (17)	63 (20)
2002	33	3.0 (1.3)	1.9 (1.0)	52 (20)	29 (18)
2003	30	2.7(0.9)	2.0(0.7)	55(19)	14(13)

*Value adjusted due to 2 nights of effort at one station.

Table 6. Mean relative weight values by length categories (90% CI are in parentheses) for black crappie from frame nets at Angostura Reservoir, 1999-2002. S-Q = stock to quality length; Q-P = quality to preferred length; P-M = preferred to memorable length.

Year	Mean Wr for Black Crappie			
	Sub-stock	S-Q	Q-P	P-M
2000	NA	113.8(2.4)	102.5(0.6)	97.2(0.7)
2001	108.1(15.8)	94.0(54.3)	98.7(12.2)	96.6(3.6)
2002	97.5(1.8)	100.5(1.0)	103.0(3.9)	95.2(5.5)
2003	105.2(3.0)	108.8(1.8)	105.2(1.1)	98.5(--)

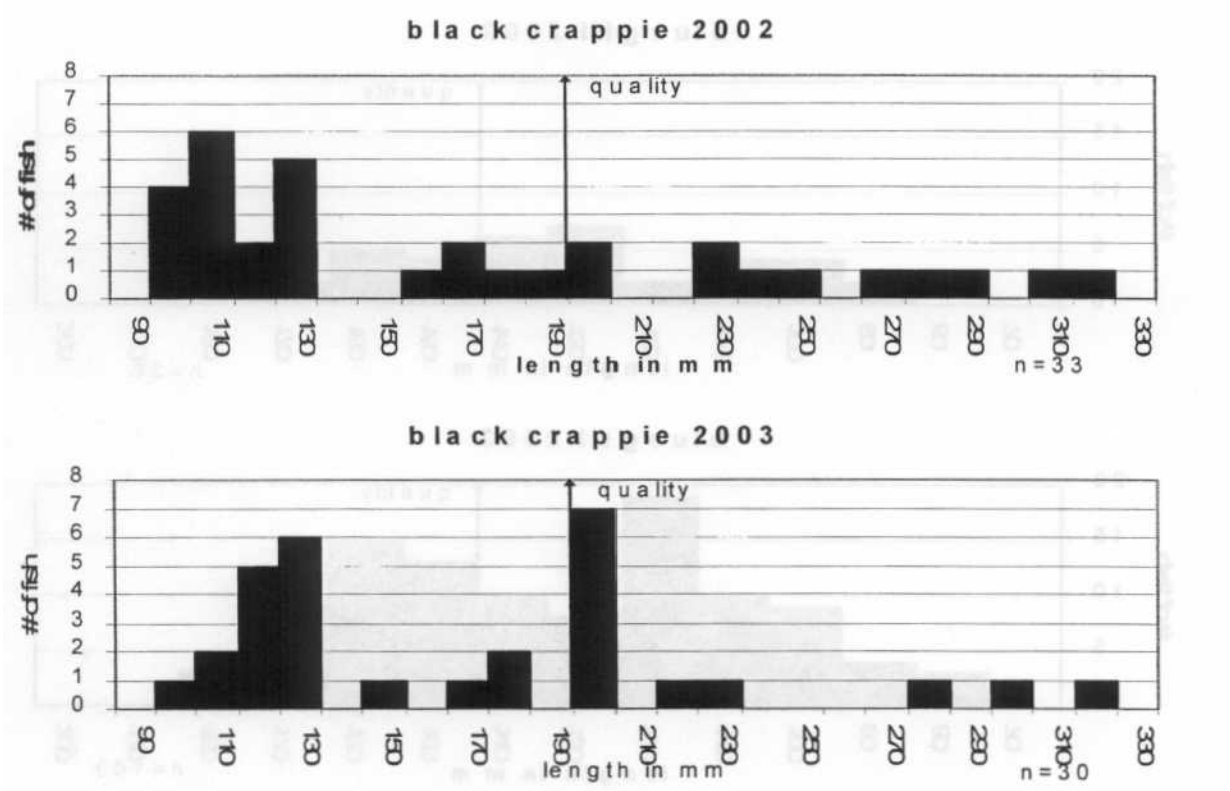


Figure 1. Length histogram of black crappies collected in trap nets from Angostura Reservoir, Fall River County 2002-2003.

Bluegill

Last year, bluegill were the most abundant fish captured in frame nets. This year they remain the most abundant panfish sampled in our frame nets. Mean CPUE in trap nets was 9.4 during the 2003 survey compared to 3.3 in 2002 (Table 7). Size of bluegills sampled ranged from 80 to 180mm (Figure 2). Stock density indices were low. The 103 fish sample yielded a PSD of 39 and a RSD-P of 0 (Table 7). Bluegill condition was good with a mean Wr for stock length and larger fish of 100.9 (Table 4).

Table 7. Composite listing of sample size (N), catch per net night (CPUE; 80% CI's in parentheses), and proportional stock densities (PSD, RSD; 90% CI's in parentheses) for bluegill collected by frame nets in Angostura Reservoir, 2000-2003.

Year	N	CPUE	PSD	RSD-P
2000	24	2.1(1.8)	25(15)	0(na)
2001	86	7.2(5.0)	9(5)	0(na)
2002	36	3.3(2.3)	31(14)	0(na)
2003	103	9.4(5.2)	39(8)	0(na)

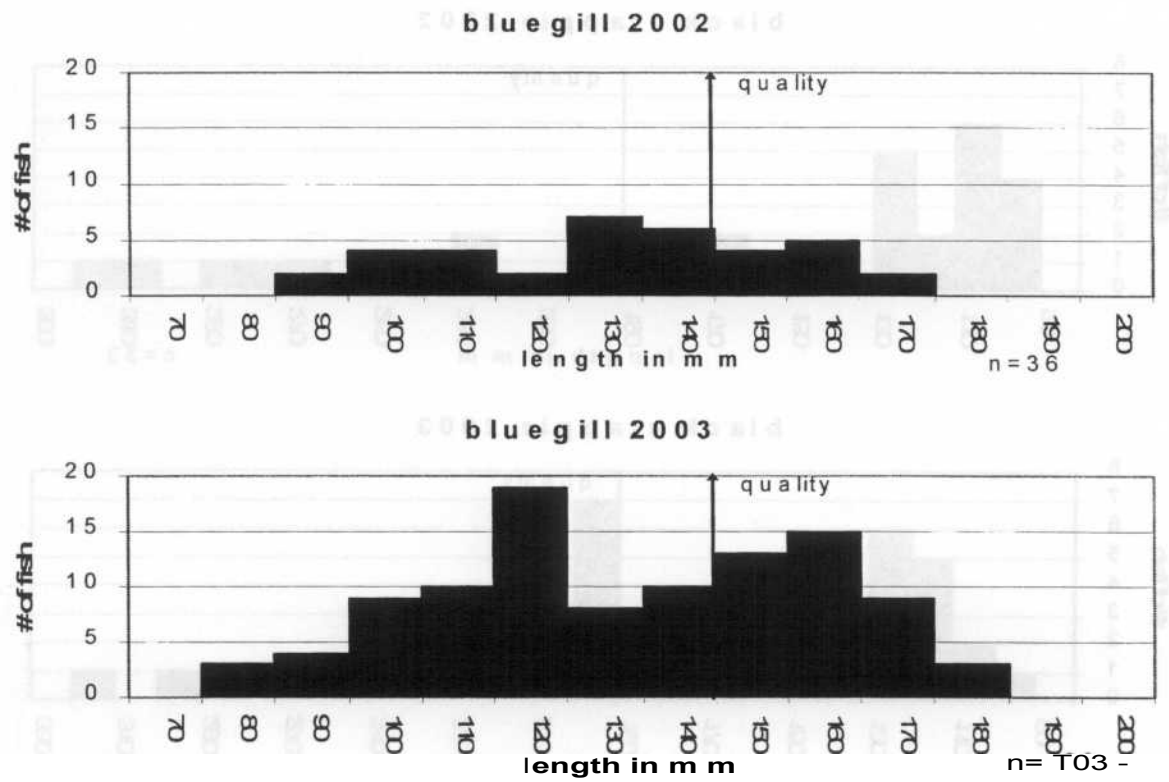


Figure 2. Length histogram of bluegill collected in trap nets from Angostura Reservoir, Fall River County, 2002-2003.

Channel Catfish

Channel catfish were the most abundant fish collected in gill nets and trap nets (Tables 3 and 4). Gill net mean CPUE for all catfish was 58.3, and for fish stock length and greater mean CPUE was 16.5 (Table 8). Stock density indices were very low; PSD=8, RSD-P=0 (Table 8). The length frequency histogram (Figure 3) shows few catfish over 290mm. Mean Wr for stock length and larger catfish was 85.5 (Table 3).

Table 8. Composite listing of sample size (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock-length fish (CPUE-S; 80% CI's in parentheses) and proportional stock densities (PSD, RSD; 90% CI's in parentheses) for channel catfish collected by gillnets in Angostura Reservoir, 1997-2003.

Year	N	CPUE	CPUE-S	PSD	RSD-P
1997	89	29.7(35.9)	14.0(14.6)	22(6)	1(1)
1998	52	17.3(16.6)	10.4(11.0)	10(5)	2(3)
2000	483	96.6(33.1)	50.8(17.1)	20(4)	3(2)
2001	339	67.8(49.2)	31.4(26.3)	20(6)	2(2)
2002	351	87.8(29.8)	15.5(17.8)	3(4)	0(--)
2003	233	58.3(26.4)	16.5(6.0)	8(6)	0(--)

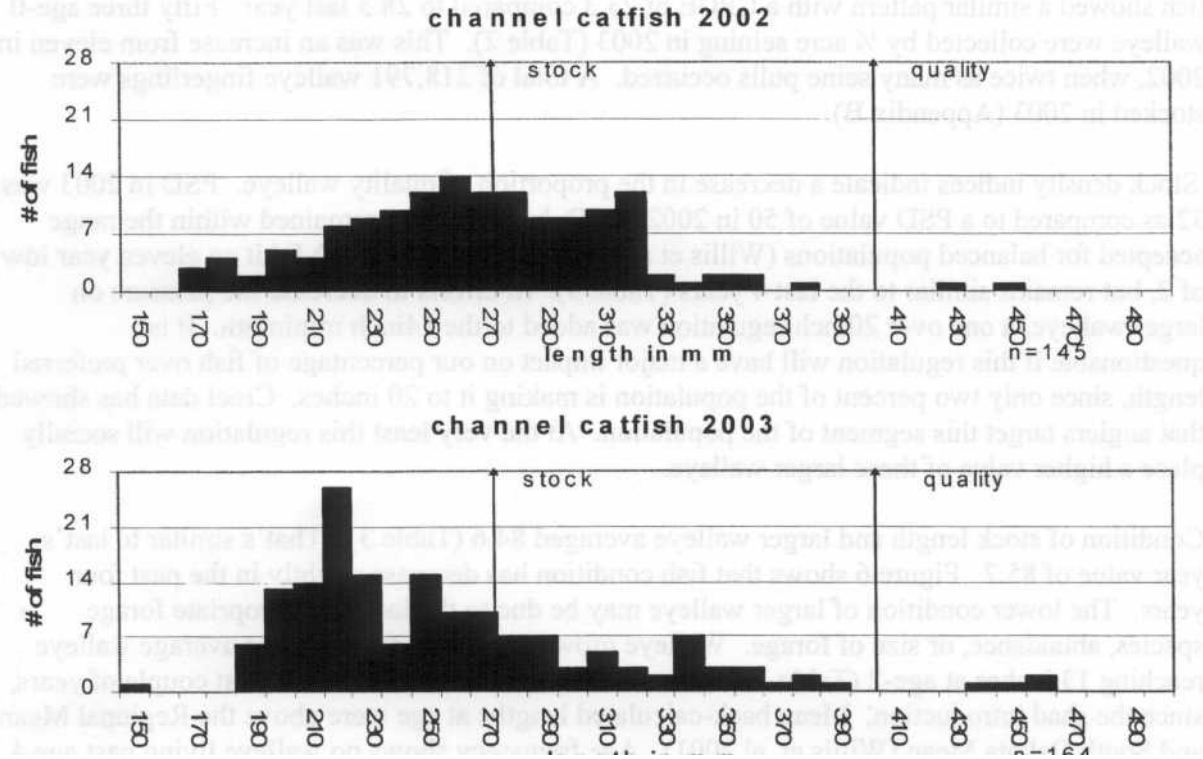


Figure 3. Length frequency histogram of channel catfish collected in gill nets from Angostura Reservoir, Fall River County, 2002-2003.

Gizzard shad

Gill net CPUE for shad >stock length was 1.5, this is down from 2.5 last year. Condition of the larger fish was high with a mean Wr = 104.1 (Table 4).

Gizzard shad were introduced to Angostura Reservoir in 1990 to provide forage for game fish, especially walleye, which were experiencing slow growth, poor condition and high mortality. The first age-0 gizzard shad were collected in 1994 during the ¼ arc seine survey. During the seining survey, 1,684 young of the year shad were collected (Table 2). No adult gizzard shad have been stocked in Angostura Reservoir since 1994. The northern latitude of South Dakota and subsequent cold winter water temperatures is most likely causing over-winter mortality of gizzard shad on an annual basis. Limited winter mortality of gizzard shad is desirable to keep densities of adult shad low while maintaining a high reproductive potential. Due to the continued presence of age-0 shad and a few adults during annual gill net sampling, we can conclude that some survival of adult shad is occurring and the surviving adult shad can produce large year classes of juveniles.

Walleye

Angostura remains one of the most popular walleye fisheries in western South Dakota. Even with high fishing pressure, walleye abundance remains high with a gill net CPUE of 29.3 (Table

3). Last year had a slightly higher CPUE of 33.8 (Table 9). CPUE for stock length and larger fish showed a similar pattern with a CPUE of 23.3 compared to 28.3 last year. Fifty three age-0 walleye were collected by ¼ acre seining in 2003 (Table 2). This was an increase from eleven in 2002, when twice as many seine pulls occurred. A total of 218,791 walleye fingerlings were stocked in 2003 (Appendix B).

Stock density indices indicate a decrease in the proportion of quality walleye. PSD in 2003 was 32 as compared to a PSD value of 50 in 2002. PSD, however, has remained within the range accepted for balanced populations (Willis et al. 1993) since 1997. RSD-P hit an eleven year low of 2, but remains similar to the last 4 years (Table 9). In efforts to decrease the pressure on larger walleye, a one over 20inch regulation was added to the Winch minimum. It is questionable if this regulation will have a major impact on our percentage of fish over preferred length, since only two percent of the population is making it to 20 inches. Creel data has showed that anglers target this segment of the population. At the very least this regulation will socially place a higher value of these larger walleye.

Condition of stock length and larger walleye averaged 84.6 (Table 3). That's similar to last's year value of 85.7. Figure 6 shows that fish condition has decrease slightly in the past four years. The lower condition of larger walleye may be due to the lack of appropriate forage species, abundance, or size of forage. Walleye growth was very fast with the average walleye reaching 13 inches at age-2 (Table 10). These numbers were similar to the past couple of years, since the shad introduction. Mean back-calculated lengths at age were above the Regional Mean and South Dakota Mean (Willis et. al 2001). Age frequency shows no walleye living past age 4 (Figure 4). This is undoubtedly because of excessive fishing pressure once these fish reach 14-inches in length.

Table 9. Composite listing of sample size (N), catch per unit effort (CPUE; standard error is given in parentheses), mean total length (TL; standard error is given in parentheses), and proportional stock densities (PSD, RSD; 90% confidence intervals are given in parentheses) for walleye collected by gill net in Angostura Reservoir, 1992-2003.

Year	N	CPUE	PSD	RSD-P
1992		7.5	65	20
1993	101	6.3	25	8
1994		11	18	4
1995	17	1.9	59	29
1996	15	1.3	93	47
1997	51	5.7	48	10
1998	52	5.8	60	6
2000	249	49.8(15.5)	43(6)	7(3)
2001	87	17.4(11.7)	31(9)	8(5)
2002	135	33.8 (19.2)	50(8)	4(3)
2003	117	29.3(26.2)	32(8)	2(3)

Table 10. Angostura Reservoir walleye year class, age in 2003, sample size (N), mean back-calculated total length-at-age, population standard error (SE), 2002 Angostura mean length-at-age, the Region 1 and South Dakota walleye mean length-at-ages (Willis et al. 2001).

Year Class	Age	N	Age 1	2	3	4
2002	1	25	192			
2001	2	35	172	303		
2000	3	19	217	337	410	
1999	4	8	225	344	426	476
Mean (SE)		**87**	**201(12)**	**328(13)**	**418(8)**	**476(0)**
2001			228 (11)	360 (9)	439 (13)	492 (15)
Region 1			164 (17)	260 (22)	332 (27)	385 (32)
S.D. Mean			168 (3)	279 (6)	360 (7)	425 (8)

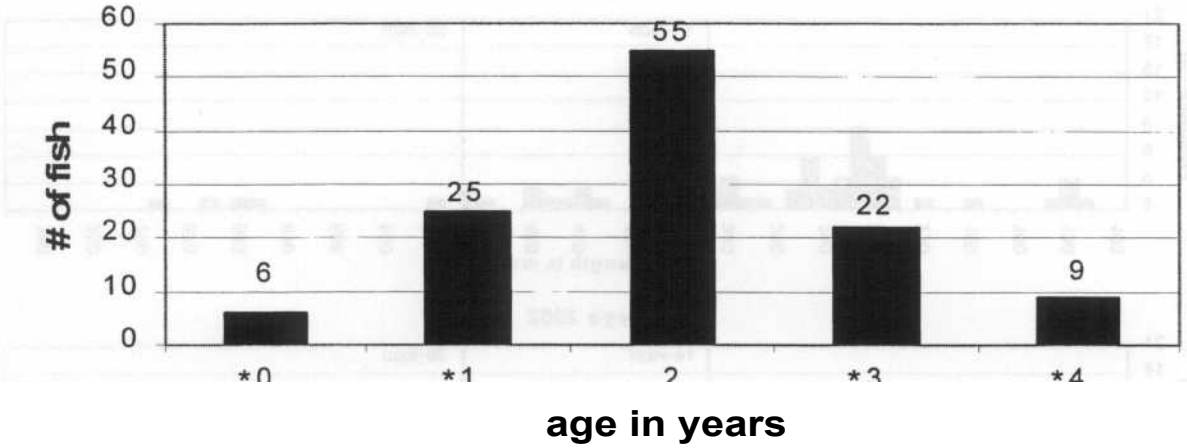


Figure 4. Age frequency histogram by year class of walleye collected by gillnets in Angostura Reservoir, 2003. An "*" indicates years when walleye were stocked.

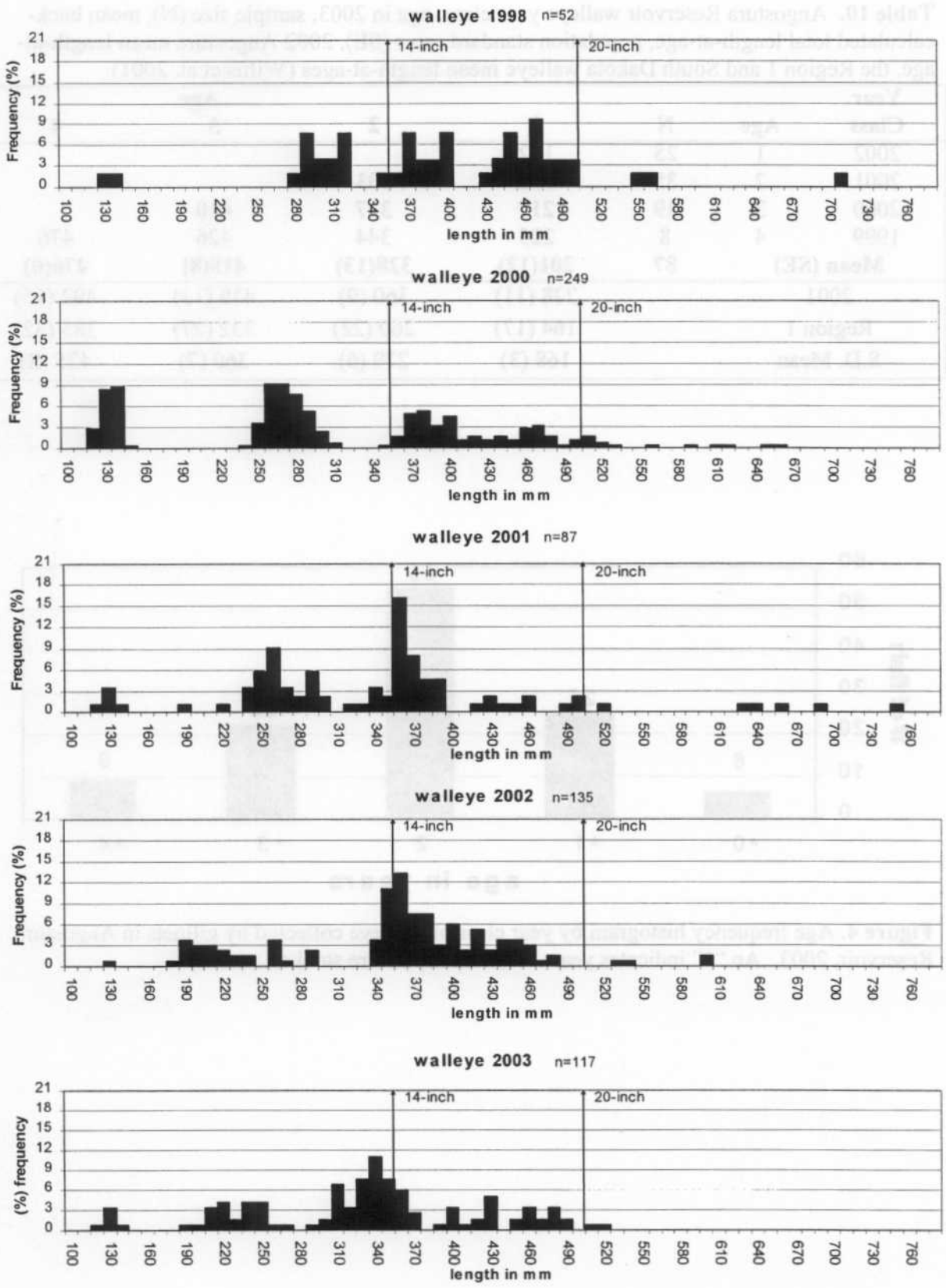


Figure 5. Length frequency histogram for walleye from gill nets at Angostura Reservoir 1998-2003.

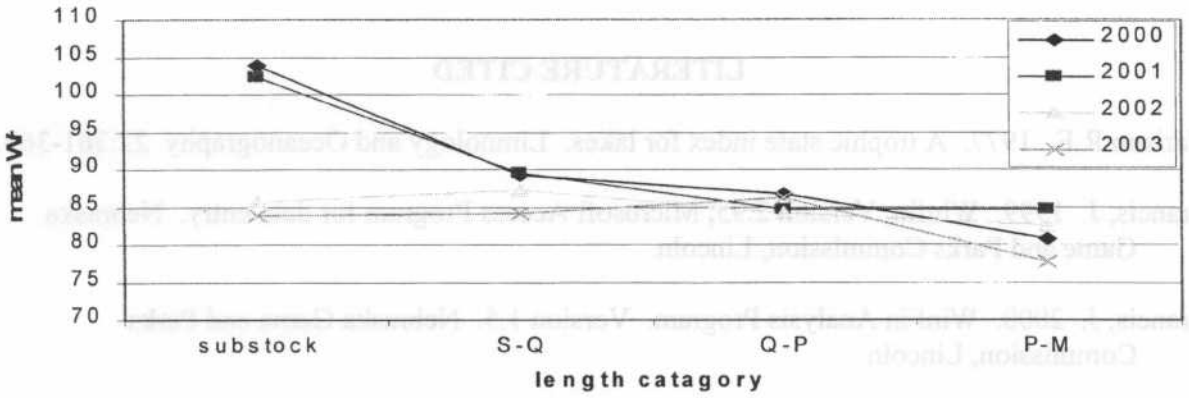


Figure 6. Mean Wr for different length categories of walleye from 2000-2003 lake surveys.

Smallmouth bass

Our gill nets sampled 39 smallmouth bass (Table 3). In 2002, only three bass were sampled by gill nets. Stock indices showed a balanced population with a PSD of 40 and a RSD-P of 20 (Table 3). Fish condition was also good with a mean Wr for stock length and larger fish of 98.3. No electrofishing was done due to low water.

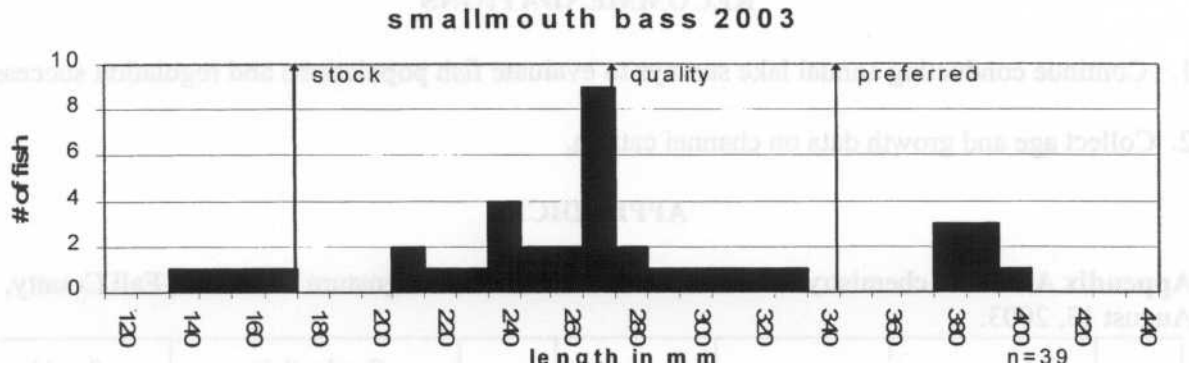


Figure 7. Length frequency histogram for smallmouth bass from gill nets at Angostura Reservior, August 6-7, 2003.

Yellow perch

Angostura's perch population remains low. This is probably due to high predator abundance and poor perch habitat. CPUE was 3.0, compared to 2002's CPUE at 8.5. Yellow perch size ranged from 110 mm to 220 mm. Fish condition was average for Angostura with a mean Wr for stock length and larger fish of 85.3. Due to small sample size, age and growth analysis was not completed.

Other fish species

Seven other fish species were collected during the annual lake survey, they include; common carp, freshwater drum, green sunfish, largemouth bass, northern pike, river carpsucker and shorthead redhorse (Tables 3 and 4). The most abundant of these were river carpsucker and common carp.

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RECOMMENDATIONS

1. Continue conducting annual lake surveys to evaluate fish populations and regulation success.
2. Collect age and growth data on channel catfish.

APPENDICES

Appendix A. Water chemistry results from sites 1, 2, and 3 Angostura Reservoir, Fall County, August 13, 2003.

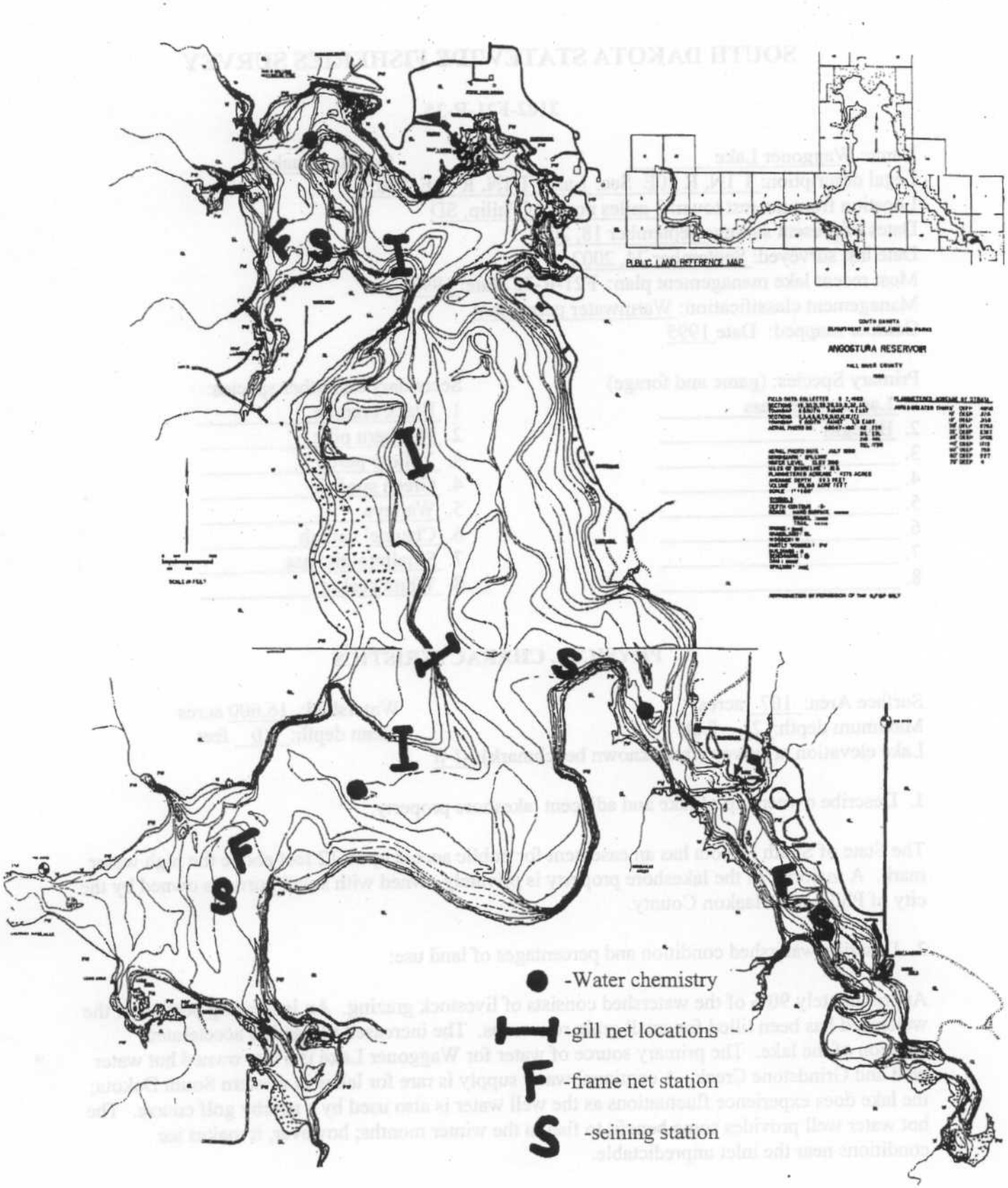
Site	Depth (ft)	Temp (°C)	D.O. (mg/l)	pH	Conductivity (umhos/cm)	Secchi disk (ft)
1	surface	26.6	7.28	8.5	2694	
	2.4	26.2	8.0	8.4	2689	
	4.6	26.0	8.3	8.4	2688	
	8.0	26.0	8.3	8.4	2685	
	10.4	25.9	8.2	8.4	2679	
	13.4	25.8	8.0	8.4	2677	
	16.6	25.8	8.0	8.4	2674	
	21.2	25.7	7.9	8.4	2666	
	23.3	25.4	7.8	8.3	2633	
	25.3	23.9	7.7	8.0	2569	
	28.7	22.2	7.0	7.9	2385	
	30.4	20.1	4.2	7.8	2340	
	32.2	19.2	3.3	7.7	2313	
	36.7	18.8	2.6	7.6	2290	
	38.0	18.4	2.1	7.6	2276	

	42.1	18.1	1.5	7.6	2266	
	48.3	17.7	1.1	7.5	2258	
	54.7	17.6	0.7	7.5	2251	
	56.4	17.4	0.5	7.4	2240	
2	surface	27.6	6.9	8.2	2652	
	2.0	25.0	7.6	8.3	2639	
	4.2	25.0	7.6	8.3	2639	
	7.0	25.0	7.6	8.3	2639	
	11.0	24.9	7.5	8.3	2634	
	15.1	24.9	7.4	8.3	2631	
	18.6	24.6	7.1	8.2	2611	
	22.2	24.1	6.9	8.1	2569	
	25.3	23.1	5.1	7.9	2513	
	27.3	22.5	4.2	7.8	2464	
	32.0	20.0	2.3	7.6	2351	
	35.4	19.2	1.2	7.5	2316	
	39.4	18.2	0.6	7.3	2258	
3	surface	25.8	7.4	8.2	2658	
	2.8	25.3	7.3	8.1	2653	
	4.3	25.2	7.3	8.1	2653	
	7.5	25.1	7.3	8.1	2651	
	11.9	25.0	7.1	8.1	2643	
	14.3	24.5	7.0	8.0	2604	
	16.8	23.8	5.8	7.8	2567	
	18.8	23.2	0.8	7.0	2447	

Appendix B. Stocking record for Angostura Reservoir, Fall River County, 1990-2003.

Year	Number	Species	Size
1990	310	Gizzard shad	Adult
	450	Emerald shiner	Adult
	99,754	Walleye	Fingerling
1991	250,000	Largemouth bass	Fingerling
	500	Gizzard shad	Adult
	235,000	Walleye	Fingerling
1992	300	Gizzard shad	Adult
	235,000	Walleye	Fingerling
1993	150,000	Largemouth bass	Fingerling
	235,000	Walleye	Fingerling
1994	43	Gizzard shad	Adult
	67,870	Largemouth bass	Fingerling
1995	100,000	Largemouth bass	Fingerling
	204,555	Walleye	Fingerling
1996	135,387	Largemouth bass	Fingerling
	354,070	Walleye	Fingerling
1997	no fish stocked		
1998	109,962	Largemouth bass	Fingerling

	201,084	Walleye	Fingerling
1999	15	Gizzard shad	Adult
	48,000	Largemouth bass	Fingerling
	248,280	Walleye	Fingerling
2000	97,133	Rainbow trout	Fingerling
	207,779	Walleye	Fingerling
2001	12,638	Largemouth bass	Fingerling
	37,000	Rainbow trout	Fingerling
2002	50,100	Walleye	Fingerling
	30,000	Smallmouth bass	Fingerling
2003	218,791	Walleye	Fingerling
	80,000	Rainbow trout	Fingerling



Appendix C. Sampling locations on Angostura Reservoir.

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-35

Name: Waggoner Lake County: Haakon
Legal description: T 1N, R 20E Sec. 1 and T 1N, R 21E Sec. 6
Location from nearest town: 3 miles north of Philip, SD
Dates of present survey: September 18, 2003
Date last surveyed: September 24, 2002
Most recent lake management plan: F21-R-32 Date: 1998
Management classification: Warmwater permanent
Contour mapped: Date 1995

Primary Species: (game and forage)
1. Largemouth bass
2. Bluegill
3.
4.
5.
6.
7.
8.

Secondary and other species:
1. Black crappie
2. Northern pike
3. Yellow perch
4. Green sunfish
5. Walleye
6. Channel catfish
7. Smallmouth bass
8. White sucker

PHYSICAL CHARACTERISTICS

Surface Area: 107 acres; Watershed: 16,600 acres
Maximum depth: 21 feet; Mean depth: 10 feet
Lake elevation at survey (from known benchmark): -1 ft

1. Describe ownership of lake and adjacent lakeshore property:

The State of South Dakota has an easement for public access up to 12 feet above the high water mark. A majority of the lakeshore property is privately owned with small portions owned by the city of Philip and Haakon County.

2. Describe watershed condition and percentages of land use:

Approximately 90% of the watershed consists of livestock grazing. An increasing portion of the watershed has been tilled for small grain row crops. The increased tillage has accelerated siltation of the lake. The primary source of water for Waggoner Lake is a city owned hot water well and Grindstone Creek. A continual water supply is rare for lakes in western South Dakota; the lake does experience fluctuations as the well water is also used by a nearby golf course. The hot water well provides some benefit to fish in the winter months; however, it makes ice conditions near the inlet unpredictable.

3. Describe aquatic vegetative condition:

Emergent vegetation is limited to bulrushes and cattails, which are abundant in the bays and inlet areas of the lake. Submerged vegetation is a problem annually in mid-summer. Coontail and curly leaf pondweed are the predominant species. Approximately fifty percent of the shoreline was covered by submergent vegetation.

4. Describe pollution problems:

There is moderate siltation from run-off. Currently no pollution problems have been detected by Departmental personnel during lake surveys.

5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:

The Department of Game, Fish and Parks provided cement planks for a boat ramp on the city owned property. The cement planks used for boat launching are uneven and no longer can be used to launch a boat.

Methods

Night electrofishing was conducted at Waggoner Lake on September 18, 2003. Electrofishing was conducted using a Smith-Root 7.5gpp unit with pulsed-DC. Six, ten-minute runs were conducted during this survey. All largemouth bass were collected, measured for total length (TL; mm) and weighed (g). Age and growth was not analyzed, due to recent adult stockings from other lakes. All data was entered into WinFin 2.95 (Francis 1999).

Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch per unit effort (CPUE), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr) based on length categories. Abundance was expressed as the mean catch per unit effort (CPUE; mean number per net night or mean number per hour of electrofishing). Actual pedal time (time the electrofishing unit produced current) was recorded from the digital display on the control box and used to calculate electrofishing CPUE. Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr.

Results and Discussion

Night Electrofishing Catch

Waggoner Lake was night electrofished for a total of 3800 seconds of pedal time on 9/18/2003. Conductivity was 2700 uhmos with a water temperature of 14.6 degrees Celsius. Only largemouth bass (N=39) and smallmouth bass (N=0) were targeted. Most largemouth bass collected were likely a result of angler stockings from nearby ponds. Smallmouth bass have been sampled in Waggoner in the past, but none were caught this year. Smallmouth bass were either accidentally or illegally stocked into Waggoner Lake. There are no records indicating the

Game, Fish and Parks Department has introduced or has intended to introduce smallmouth bass into Waggoner Lake.

Table 1. Total catch (N), catch per hour of electrofishing (CPUE) with 80% Cl's in parentheses, catch per hour of stock length fish (CPUE-S) with 80% Cl's, proportional stock densities (PSD, RSD-P) with 90% Cl's in parentheses, and mean (Wr) for fish over stock length with 90% Cl's in parentheses for largemouth bass and smallmouth bass collected by electrofishing in Waggoner Lake, Haakon County, September 18, 2003.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr≥S
Largemouth bass	39	38.5(21.5)	18.8(10.7)	95(9)	58(20)	115(3)
Smallmouth bass	0					
Totals	39					

Largemouth bass

A total of 39 largemouth bass were captured during night electrofishing (Tables I and 2). Mean CPUE was 38.5 for all largemouth bass and 18.8 for bass that were stock length or greater. Stock indices have improved for the third straight year. In 2001, PSD was 52 with an RSD-P of 0; the 2002 survey gave a PSD of 71 and RSD-P of 4. This year PSD was 95 with an RSD-P of 58 (Table 1 and 2). Fish condition was excellent with a mean Wr for stock length and greater fish of 115. All length categories had Wr values well over 110. Figure 1 shows an upcoming year class, which is the first in several years.

Waggoner apparently suffered a partial winterkill during the winter of 1999-2000. To supplement the population, Game, Fish and Parks personnel, with help from local anglers, removed fish from local ponds with overabundant bass populations and relocated 900 adult bass to Waggoner Lake in 2001. Since these fish would not give an accurate picture of growth rates, age and growth was not analyzed in 2003. In addition to the supplemental stocking, a slot limit has been implemented to help protect the bass population. Fish 12 to 16 inches must be released with only one fish over 16 inches being allowed in the daily limit of five.

Table 2. Total catch (N), pedal time (seconds), catch per hour of electrofishing (CPUE), mean total length (TL, standard error is given in parentheses), and proportional stock densities (PSD, RSD; 90% confidence intervals are given in parentheses) for largemouth bass collected by electrofishing in Waggoner Lake, Haakon County, 1996-2003.

Year	N	Pedal Time (sec)	CPUE	CPUE-S	PSD	RSD-P
1996	96	2,942	117.5	111.4	66(8)	29(8)
1997	88	6,944	45.6	42.5	63(8)	24(8)
1998	107	4,200	91.7	90.9	72(8)	24(7)
1999	111	6,350	62.9	62.4	56(8)	17(6)
2000	19	4,140	18.1	18.1	74(18)	16(15)
2001	56	6,028	33.5	26.3	52(13)	0 (-)
2002	24	2,959	29.2	29.2	71(16)	4(7)
2003	39	3,800	38.5	18.8	95(9)	58(20)

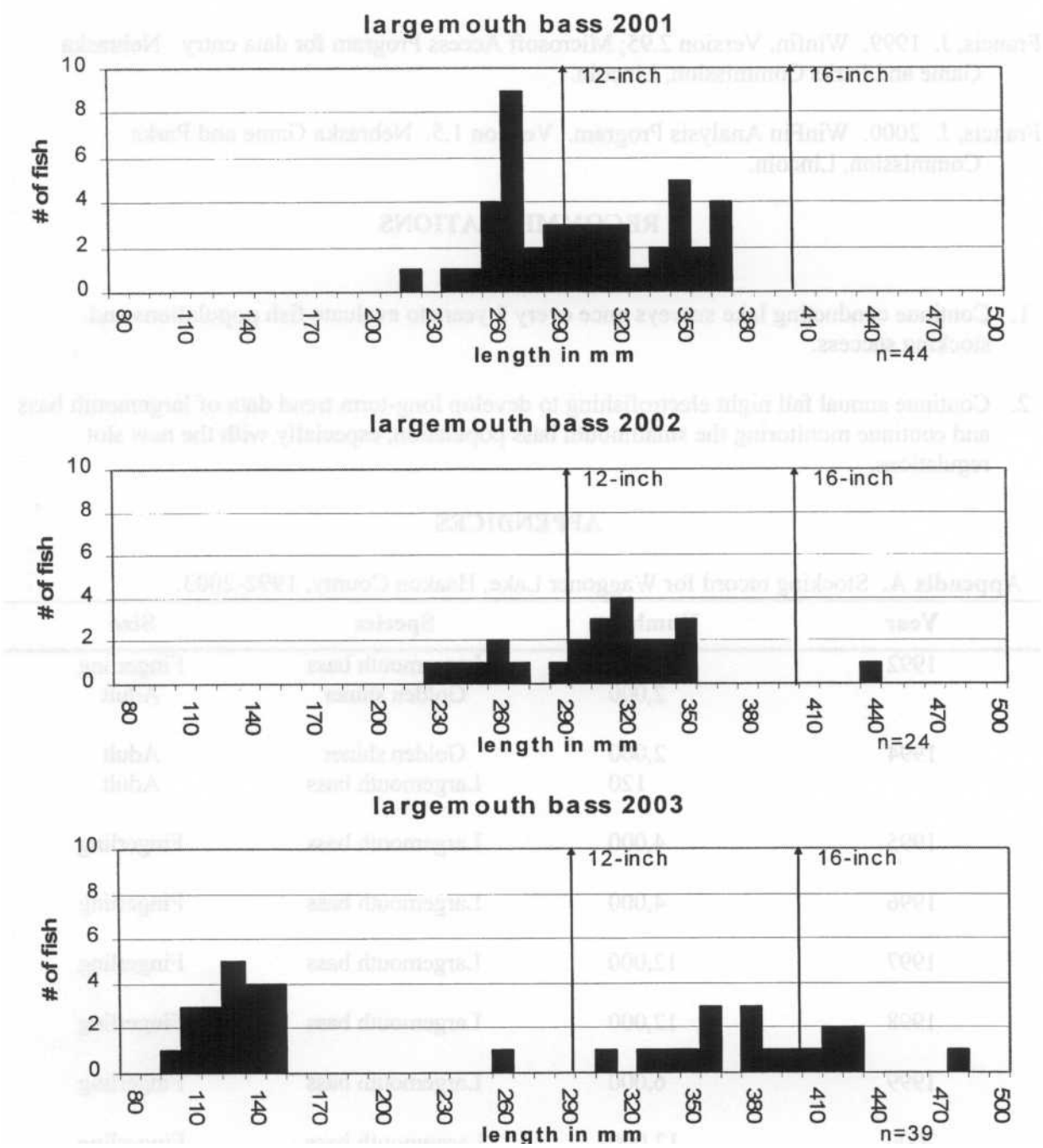


Figure 1. Length frequency histogram for largemouth bass in Waggoner Lake, Haakon County 2001-2003.

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Francis, J. 2000. WinFin Analysis Program. Version 1.5. Nebraska Game and Parks Commission, Lincoln.

RECOMMENDATIONS

1. Continue conducting lake surveys once every 3 years to evaluate fish populations and stocking success.

2. Continue annual fall night electrofishing to develop long-term trend data of largemouth bass and continue monitoring the smallmouth bass population, especially with the new slot regulations.

APPENDICES

Appendix A. Stocking record for Waggoner Lake, Haakon County, 1992-2003.

Year	Number	Species	Size
1992	9,000	Largemouth bass	Fingerling
	2,000	Golden shiner	Adult
1994	2,000	Golden shiner	Adult
	120	Largemouth bass	Adult
1995	4,000	Largemouth bass	Fingerling
1996	4,000	Largemouth bass	Fingerling
1997	12,000	Largemouth bass	Fingerling
1998	12,000	Largemouth bass	Fingerling
1999	6,000	Largemouth bass	Fingerling
2000	12,000	Largemouth bass	Fingerling
2001	905	Largemouth bass	Adults
	12,620	Largemouth bass	Fingerling
2002	none		
2003	none		

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-36

Name: Gardner Lake County(ies): Harding
Legal description: T 19 N, R 4 E Sec. 10, 15, 22
Location from nearest town: 3 miles west and 1 mile north of Buffalo, SD
Dates of present survey: June 23-25, 2003
Date last surveyed: June 29-30, 1999
Most recent lake management plan: F21-R-30 Date: 1998
Management classification: Warmwater permanent
Contour mapped: Date 1985

Primary Species: (game and forage)	Secondary and other species:
1. Walleye	1. Black bullhead
2. Black crappie	2. Common carp
3. Yellow perch	3. White sucker
4.	4. River carpsucker
5.	5. Spottail shiner
6.	6. Fathead minnow
7.	7. Largemouth bass
8.	8. Northern pike

PHYSICAL CHARACTERISTICS

Surface Area: 203 acres; Watershed: 13,340 acres
Maximum depth: 8 feet; Mean depth: 5 feet
Lake elevation at survey (from known benchmark): -4 feet

1. Describe ownership of lake and adjacent lakeshore property:
South Dakota Department of Game, Fish and Parks owns most of the land adjacent to Gardner Lake. However, three small lakeside portions are privately owned. Game, Fish and Parks has easements, including public access, on this land.

2. Describe watershed condition and percentages of land use:
The Gardner Lake watershed is approximately 21 square miles and consists primarily of private land used for livestock grazing and limited farming.

3. Describe aquatic vegetative condition:
Due to extremely low turbid water no vegetation was observed in Gardner during the 2003 survey.

4. Describe pollution problems:
No pollution problems were identified by departmental personnel during the 2003 survey.

5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:
In 1987-88 extensive reconstruction of the dam and spillway occurred. Since the reconstruction, problems with the spillway have been identified and are currently under consideration for repair.

CHEMICAL DATA

1.Describe general water quality characteristics.
Water chemistry parameters were collected on June 23, 2003 at an established station. Field measurements included temperature and dissolved oxygen profile, surface pH, surface conductivity and transparency (Appendix C).

2. Thermocline: No

3. Secchi disc reading:1.0 ft.

4. Stations for water chemistry located on attached lake map: Yes

BIOLOGICAL DATA

Methods
A lake survey was conducted on Gardner Lake June 23-25, 2003. Sampling consisted of 2 gill net nights and 8 trap net nights (Figure 1). All gill nets were monofilament experimental nets. Each net was 45.7-m (150-ft) long and 1.8-m (6-ft) deep with six 7.6-m (25-ft) panels of bar mesh sizes: 12.7-mm (0.5-in), 19.1-mm (0.75-in), 25.4-mm (1.0-in), 31.8-mm (1.25-in), 38.1-mm (1.5-in), and 50.8-mm (2.0-in). Trap nets were set at four stations consisting of two net nights each. All trap nets were modified fyke-nets with a 1.3-X 1.5-m frame, 19.1-mm (0.75-inch) mesh and a 1.2- X 23-m (3.9- X 75.5-ft) lead. Collected fish were measured for total length (TL; mm) and weighed (g). In addition, scale samples for the first five fish per centimeter group were collected from selected fish per gear type for age and growth analysis. Scale samples were pressed onto acetate slides and viewed with a microfiche projector (40X) and the distance between scale annuli were recorded on paper strips. All data was entered into WinFin 2.95 (Francis 1999).

Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch per unit effort (CPUE), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr) based on length categories. Abundance was expressed as the mean catch per unit effort (CPUE; mean number per net night or mean number per hour of electrofishing). Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and

RSD-P). Fish condition was expressed as mean Wr. Due to heavy rains during the 2003 survey and equipment malfunctions; few fish were weighed during this survey. Wr values may be missing for certain species and sample sizes were small.

Results and Discussion

In 1991, Gardner Lake was designated as primary water in Region 1 by the South Dakota Department of Game, Fish and Parks. This designation requires yearly monitoring of fish populations along with water chemical analysis. However, due to the balance of fish communities in Gardner Lake, lake surveys have been conducted on a 3-year basis. Currently, no lake specific harvest regulations are imposed on Gardner Lake.

Fish Community Survey

Overall, 10 species of fish were collected during the 2003 lake survey (Tables 1 and 2). The only species sampled, which was not collected during the 1999-lake survey, were shorthead red horse, channel catfish and largemouth bass. Bluegill was the only species absent from the 2003 lake survey which was previously collected. One hundred sixteen fish were collected by gill net, with common carp (38%) and spot tail shiner (35%) being the most numerous (Table 1). One hundred six fish were collected by frame nets with black crappie (63%) and walleye (15%) being the most numerous (Table 2). Population parameters of dominant game and forage species in Gardner Lake are discussed individually below.

Table 1. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock-length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD-P; 90% CI's in parentheses), and condition factor (Wr for fish ≥ stock length; 80%CI's) for all fish species collected from eight ¾ inch frame nets in Gardner Lake, Harding County June 23-25, 2003.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr ≥ S
BLC	67	8.4(1.6)	7.5(1.1)	77(10)	8(6)	--
CCF	1	0.1(0.2)	0.0(--)	--	--	--
COC	2	0.3(0.2)	0.3(0.2)	--	--	--
LMB	1	0.1(0.2)	0.1(0.2)	--	--	--
NOP	14	1.8(0.6)	1.8(0.6)	93(13)	0(--)	84.7(5.3)
WAE	16	2.0(1.0)	1.8(0.7)	79(21)	29(23)	85.3(3.5)
WHS	3	0.4(0.3)	0.4(0.3)	--	--	--
YEP	2	0.3(0.4)	0.0(--)	--	--	--
Total	106					

Table 2. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock-length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD-P; 90% CI's in parentheses), and condition factor (Wr for fish ≥ stock length; 80%CI's) for all fish species collected from two 150-ft experimental sinking gill nets in Gardner Lake, Harding County, June 23-25, 2003.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr ≥ S
BLC	9	4.5(4.6)	2.5(1.5)	80(43)	0	88.7(7.5)
CCF	4	2.0(0)	2.0(0)	--	--	94.1(4.7)
COC	44	22.0(0)	22.0(0)	9(7)	0	88.9(0.8)
NOP	5	2.5(1.5)	2.5(1.5)	100(--)	20(43)	80.5(6.5)
SHR	1	0.5(1.5)	0.5(1.5)	--	--	--
SPS	41	20.5(32.3)	--	--	--	--
WAE	10	5.0(3.1)	5.0(3.1)	100(--)	10(18)	84.9(1.8)
WHS	2	1.0(0)	1.0(0)	--	--	87.6((5.1)
Total	116					

Walleye

Gardner continues to maintain a low density walleye population through natural reproduction. Even though the lake hasn't been stocked since 1983, several year classes are evident on the length frequency histogram (Figure 1). Gill net CPUE was 5.0 and frame net CPUE was 2.0. These numbers are similar to the 1999 survey when CPUE was 8.0 and 1.3, respectively. With such small sample sizes, stock indices are hard to compare. The gill net sample yielded a mean Wr for stock length and larger walleye of 84.9 (Table 2). Growth for the 18 fish sample was above the regional average and above the state average until age 5 (Table 3). Gardner appears to have a low-density, fast growing, self-sustaining walleye population. To provide a higher density population, large fall fingerling should be stocked biannually to supplement the existing population to provide more consistent walleye fishing. An increased predator density should also help keep carp numbers in

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Table 3. Gardner Lake walleye, year class, age in 2003, sample size (N), mean back-calculated total length at age, population standard error (SE), the Region 1 and South Dakota walleye mean length at ages (Willis et al. 2001).

Year Class	Age	N	Age 1	2	3	4	5	6
2002	1	2	108					
2001	2	2	146	302				
2000	3	7	203	327	406			
1999	4	5	177	282	354	449		
1997	6	2	185	287	363	413	459	524
Mean(SE)		**18**	**164(17)**	**300(10)**	**374(16)**	**431(18)**	**459(0)**	**524(0)**
Region1(SE)			164 (17)	260(22)	332(27)	385(32)	444(42)	
S.D. Mean			168(3)	279(6)	360(7)	425(8)	490(9)	

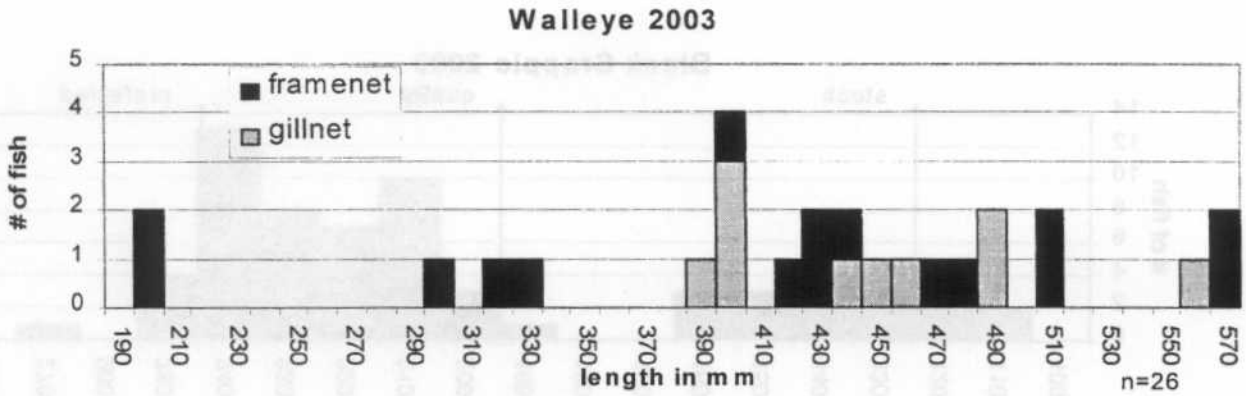

Figure 1. Length frequency histogram of walleye collected by gill nets and frame nets in Gardner Lake, June 23-25, 2003.

Black crappie

Black crappie was the most abundant fish sampled in the frame nets as they were in the 1999 survey. Frame net CPUE was 8.4 compared to 74.1 in 1999. Apparently a large year class has left the system, probably through natural mortality. Stock indices yielded a more balanced population than last survey with a PSD of 77 and an RSD-P of 8.(Table 4) In 1999, it was 98 and 0, respectively. Years of low water may be suppressing crappie recruitment at this time, as these are the lowest catch rates since crappie were stocked in 1996 (Table 4). Growth was slightly faster the regional average (Table 5).

Table 4. Composite listing of sample size (N), catch per unit effort (CPUE; standard error is given in parentheses), mean total length (TL; standard error is given in parentheses), and proportional stock densities (PSD, RSD; 90% confidence intervals are given in parentheses) for black crappie collected by frame nets in Gardner Lake, 1994-2003.

Year	N	CPUE	PSD	RSD-P
1994	0	0		
1996	253	31.2	95	45
1999	593	74.1	98 (1)	0 (--)
2003	67	8.4(1.6)	77(10)	8(6)

Table 5. Gardner Lake black crappie, year class, age in 2003, sample size (N), mean back-calculated total length at age, population standard error (SE), the Region 1 walleye mean length at ages (Willis et al. 2001).

Year			Age				
Class	Age	N	1	2	3	4	5
2001	2	3	63	108			
2000	3	2	56	102	142		
1999	4	9	72	128	170	212	
1998	5	7	79	128	172	212	228
Mean (SE)		**21**	**68(5)**	**117(7)**	**161(10)**	**212(0)**	**228(0)**
Region 1 Mean			74(3)	122(7)	158(9)	197(13)	217(16)

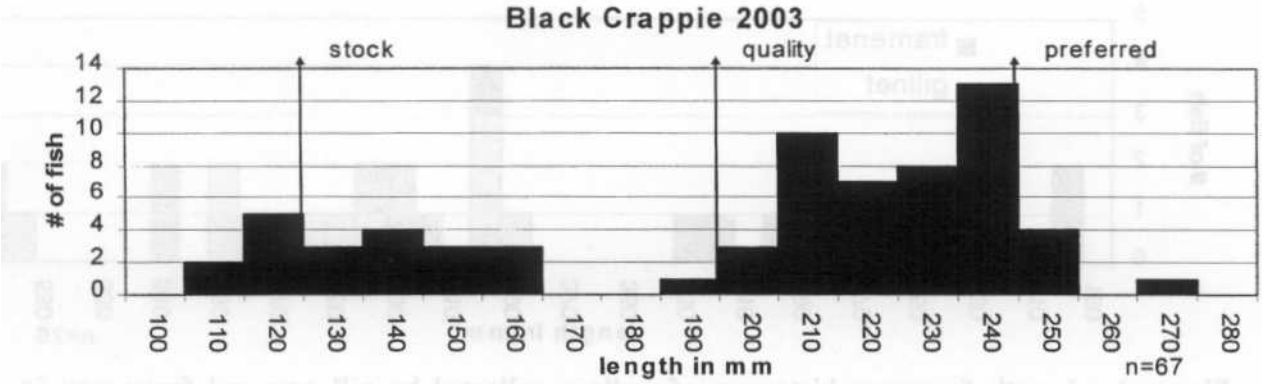

Figure 2. Length frequency histogram of black crappie collected by frame nets in Gardner Lake, June 23-25, 2003.

Common carp

Common carp numbers have increased since the last survey with a gill net CPUE of 22.0 (Table 2). In 1999, the one gill net sample captured three carp. The carp population is dominated by smaller fish with only 9% of the sampled adult population over sixteen inches (Figure 3). Low water has not seemed to hurt the carp population. Efforts should be had to increase predator densities to keep this rough fish in control.

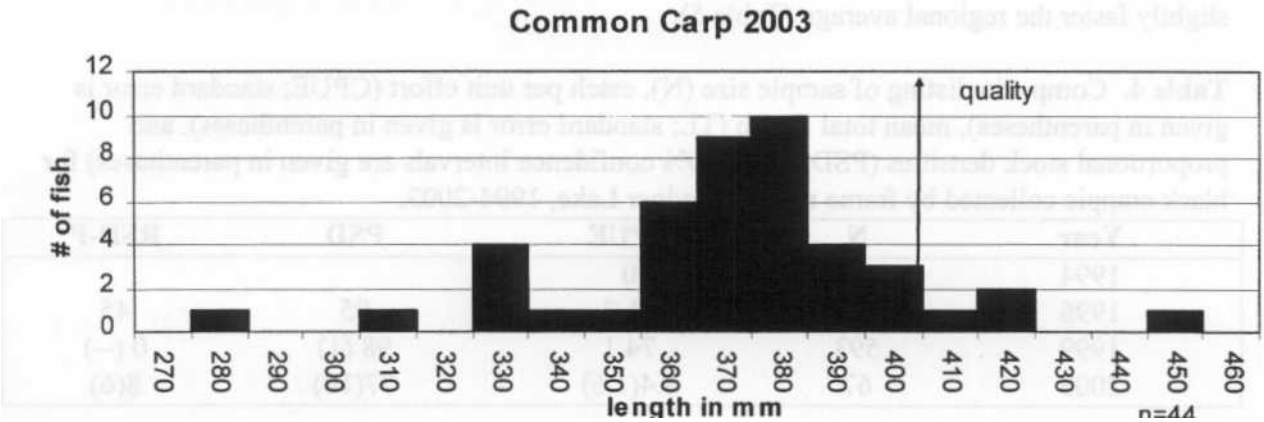

Figure 3. Length frequency histogram of common carp collected by gill nets in Gardner Lake, June 23-25, 2003.

Northern Pike

The pike population in Gardner appears to have increased with a frame net CPUE of 1.8 and a gill net CPUE of 2.5 (Tables 1 and 2). In 1999, gillnet CPUE was 0.0, and frame net CPUE was 0.1. Length frequency shows different sizes of pike indicating several year classes (Figure 4). No small pike were observed probably due to lack of spawning habitat caused by low water.

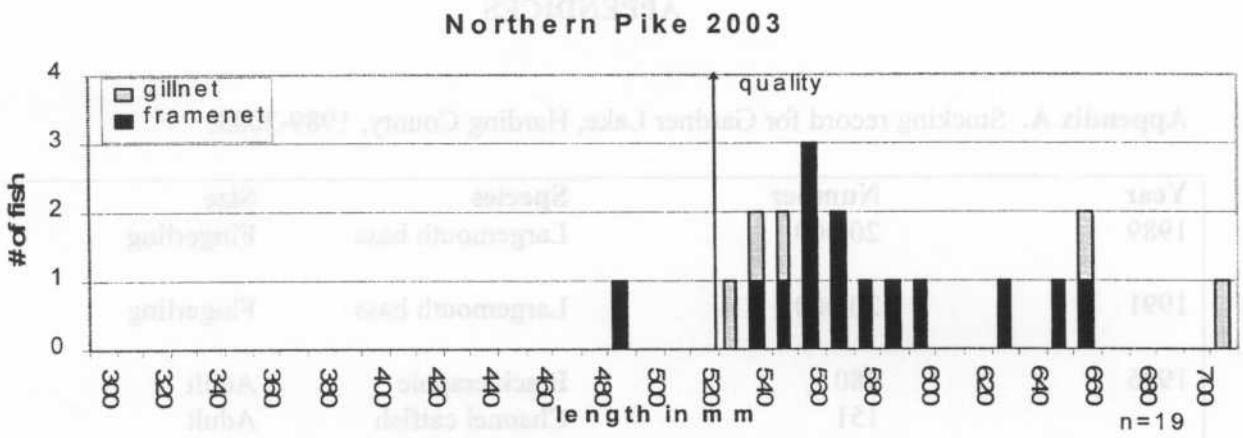

Figure 4. Length frequency histogram of northern pike collected by gill nets and frame nets in Gardner Lake, June 23-25, 2003.

LITERATURE CITED

Francis, J. 1999. Winfin, Version 2.95; Microsoft Access Program for data entry. Nebraska Game and Parks Commission, Lincoln.

Francis, J. 2000. WinFin Analysis Program. Version 1.5. Nebraska Game and Parks Commission, Lincoln.

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RECOMMENDATIONS

1. Stock Gardner with large fall walleye fingerlings at a rate of 10 per acre every other year. This should increase predator abundance which should help keep control of carp numbers, as well as help improve angler catch rates.

2. Low water has hurt yellow perch numbers as no suitable spawning habitat exists. Placing Christmas trees in Gardner should help provide perch spawning habitat, as well as provide anglers with areas that concentrate black crappie and other panfish.

3. If water conditions allow, stock prespawn yellow perch to help provide a better panfishery and increase walleye forage.

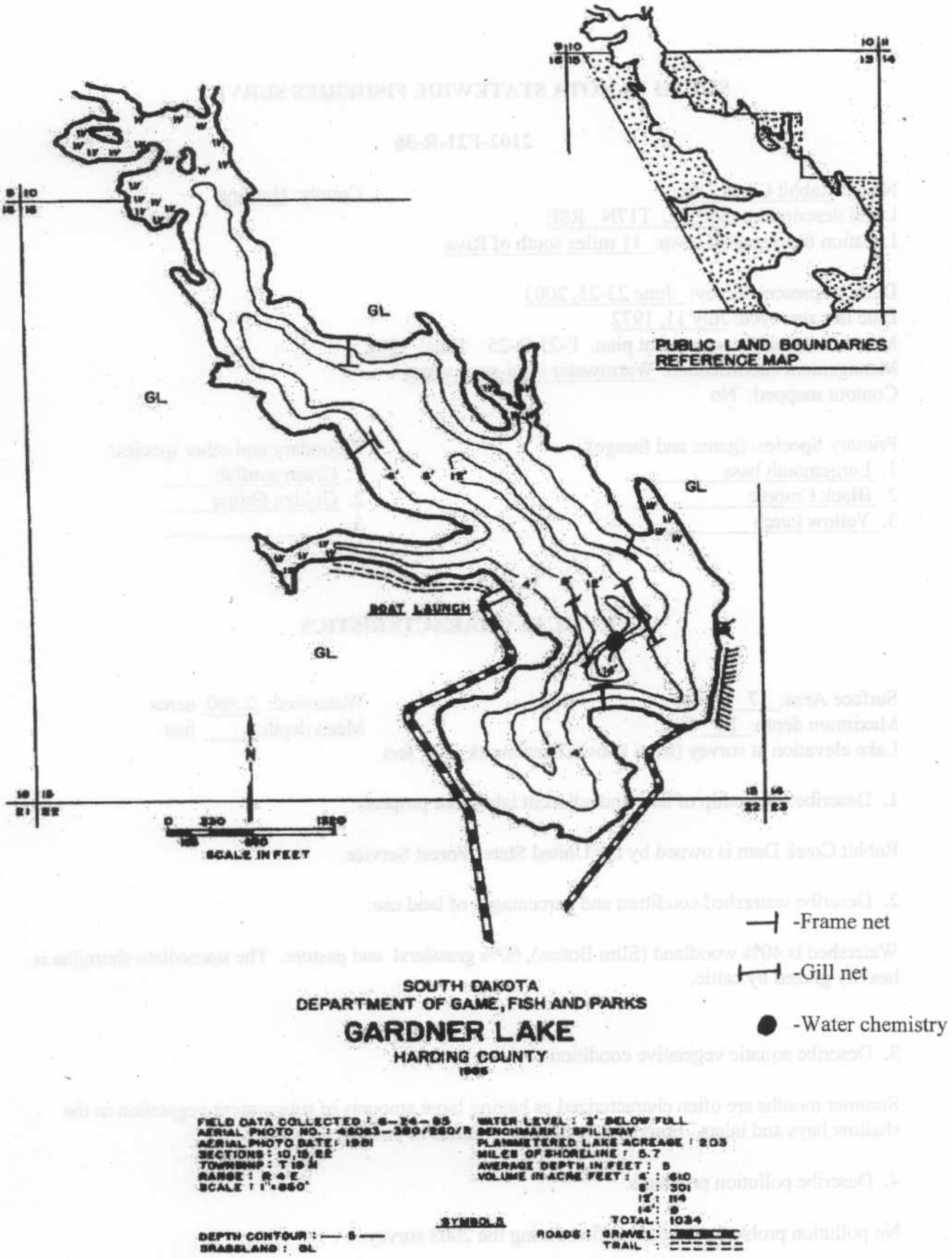
APPENDICES

Appendix A. Stocking record for Gardner Lake, Harding County, 1989-2003.

Year	Number	Species	Size
1989	20,000	Largemouth bass	Fingerling
1991	20,000	Largemouth bass	Fingerling
1996	280	Black crappie	Adult
	151	Channel catfish	Adult
1997	800	Black crappie	Adult
	60	Channel catfish	Adult
1998	107	Channel catfish	Adult
2003	310	Channel catfish	Adults

Appendix B. Water chemistry results from site A on Gardner Lake, Harding County, June 23, 2003.

Depth (ft)	Temp (°C)	D.O. (mg/l)	pH	Conductivity (*u*mhos/cm)	Secchi disk (ft)
surface	19.0	10.6	9.8		1.0
2	19.5	10.0			
4	19.5	9.8			
6	19.5	9.6			
8	19.5	9.6			



Appendix C. Map of Gardner Lake net locations

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-36

Name: Rabbit Creek Dam County: Harding
Legal description: Sec. 32. T17N R8E
Location from nearest town: 11 miles south of Riva

Dates of present survey: June 23-25, 2003
Date last surveyed: July 11, 1972
Most recent lake management plan: F-21-R-25 Date: 1992
Management classification: Warmwater semi-permanent
Contour mapped: No

Primary Species: (game and forage)	Secondary and other species:
1. Largemouth bass	1. Green sunfish
2. Black Crappie	2. Golden Shiner
3. Yellow Perch	3.

PHYSICAL CHARACTERISTICS

Surface Area: 17 acres; Watershed: 2,560 acres
Maximum depth: 14 feet; Mean depth: feet
Lake elevation at survey (from known benchmark): -1 feet

1. Describe ownership of lake and adjacent lakeshore property:

Rabbit Creek Dam is owned by the United States Forest Service.

2. Describe watershed condition and percentages of land use:

Watershed is 40% woodland (Slim Buttes), 60% grassland and pasture. The immediate shoreline is heavily grazed by cattle.

3. Describe aquatic vegetative condition:

Summer months are often characterized as having large amounts of submergent vegetation in the shallow bays and inlets. Emergent vegetation consists of bulrush and cattail.

4. Describe pollution problems:

No pollution problems were identified during the 2003 survey.

5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:

No problems were noted in the 2003 survey. Rabbit Creek Dam does not have a boat ramp.

CHEMICAL DATA

1. Describe general water quality characteristics.
Field measurements included temperature and dissolved oxygen profile, surface pH, surface conductivity and transparency (Appendix B).

2. Thermocline: No

3. Secchi disc reading: 2.Oft.

4. Stations for water chemistry located on attached lake map: No

BIOLOGICAL DATA

Methods

A lake survey was conducted at Rabbit Creek Dam on June 20-23, 2003. Sampling consisted of four trap nets that sat for two nights before being run. All trap nets were modified fyke-nets with a 1.3 X 1.5-m frame, 19.1 mm (0.75 inch) mesh and a 1.2- X 23-m (3.9- X 75.5-ft) lead. Collected fish were measured for total length (TL; mm) and weighed (g). In addition, scale samples for the first five fish per centimeter group were collected from selected fish per gear type for age and growth analysis. Scale samples were pressed onto acetate slides and viewed with a microfiche projector (40X) and the distance between scale annuli were recorded on paper strips. All data was entered into WinFin 2.95 (Francis 1999).

Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch per unit effort (CPUE), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr) based on length categories. Abundance was expressed as the mean catch per unit effort (CPUE; mean number per net night). Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr.

Results and Discussion

Rabbit Creek Dam has not been surveyed since 1972. Even without any management activity in years, it contains an excellent population of black crappie and yellow perch. Low water levels kept us from electrofishing. But judging by the size structure of the crappie and perch, it is probably a safe bet that there is a decent bass population in Rabbit Creek Dam. Equipment malfunction kept us from weighing any fish, so no condition factors were calculated. Fish parameters for black crappie and yellow perch are discussed individually below.

Table 1. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock-length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD-P; 90% CI's in parentheses) for all fish species collected from four ¾ inch frame nets in Rabbit Creek Dam, June 20-23, 2003.

Species	N	CPUE	CPUE-S	PSD	RSD-P
BLC	274	34.3(24.5)	34.0(24.4)	98(2)	31(5)
GOS	1	0.1(0.2)	--	--	--
GSF	1	0.1(0.2)	0.1(0.2)	--	--
LMB	1	0.1(0.2)	0.1(0.2)	--	--
YEP	106	13.3(11.0)	13.3(11.0)	98(2)	75(7)
total	383				

Black Crappie

Black crappie dominated the frame net catch, comprising 71.5% by number. CPUE was 34.3 (Table 1). Stock indices were high with a PSD of 98 and a RSD-P of 31. The length frequency histogram showed most fish between 210mm and 270mm (Figure 1). Growth was slower than the state average but decent for a small dam (Table 2).

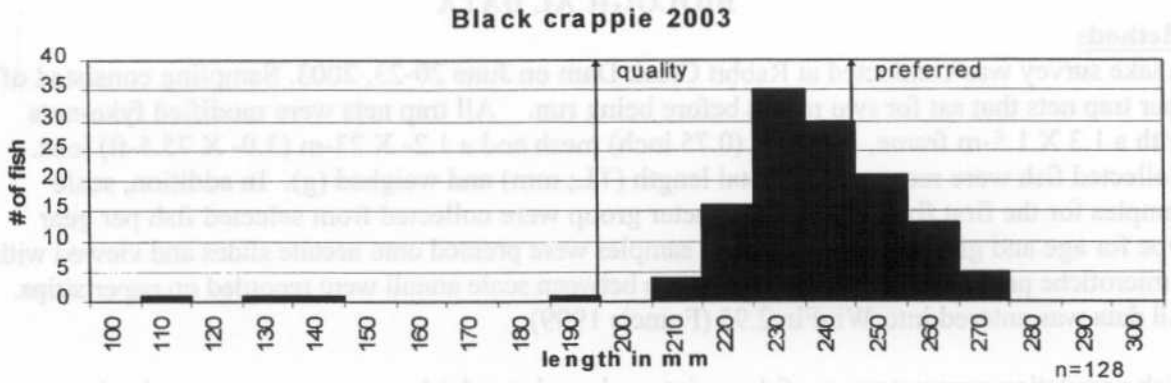


Figure 1. Length frequency histogram for black crappie from Rabbit Creek Dam on June 23, 2003.

Table 4. Rabbit Creek Dam black crappie year class, age in 2003, sample size (N), mean back-calculated total length at age, population standard error (SE), and the South Dakota black crappie mean length at age (Willis et al. 2001).

Year Class	Age	N	Age 1	2	3	4	5	6	7
2001	2	3	53	112					
2000	3	2	55	97	172				
1999	4	9	58	115	165	210			
1998	5	8	52	104	169	203	231		
1997	6	3	51	93	151	196	221	242	
1996	7	11	53	95	155	194	223	243	258
Sample size		36							
2003 Mean(SE)			**54(1)**	**103(4)**	**162(4)**	**201(4)**	**225(3)**	**243(0)**	**258(0)**
South Dakota(SE)			83(2)	147(4)	195(5)	229(6)	249(6)		

Yellow Perch

Perch CPUE was 13.3 per net night (Table 1). Size structure was dominated by fish in the 240-280mm range (Figrue 2). PSD was 98 and RSD-P was 75. Smaller fish didn't show up in our frame net sample. With no gill net set, it is hard to say if no smaller fish are in the lake. Growth was excellent, well above the statewide average (Table 6).

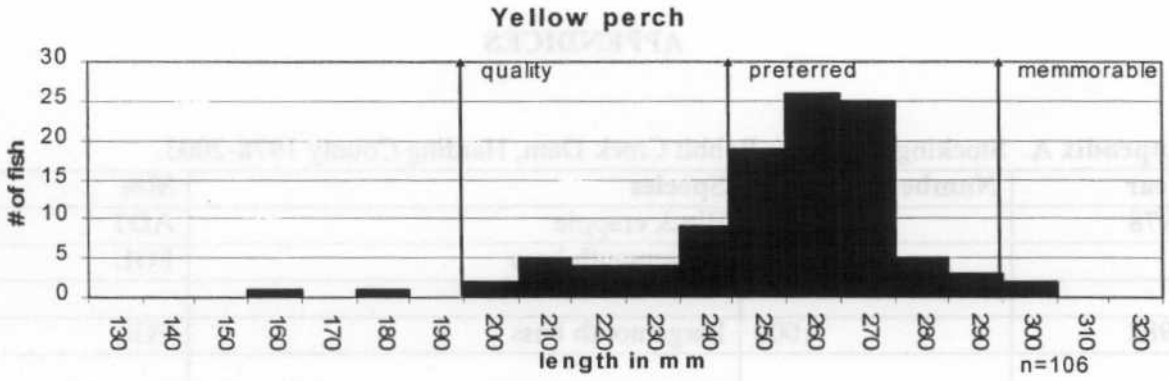


Figure 2. Length frequency histogram for yellow perch sampled by frame nets in Rabbit Creek Dam, June 23, 2003.

Table 6. Rabbit Creek Dam yellow perch year class, age in 2003, sample size (N), mean back-calculated total length at age, population standard error (SE), and the South Dakota yellow perch mean length at age (Willis et al. 2001).

Year Class	Age	N	Age 1	2	3	4	5	6
2001	2	2	66	141				
2000	3	11	64	132	205			
1999	4	17	68	149	216	249		
1998	5	7	69	155	220	248	265	
1997	6	1	88	177	203	245	272	285
Sample size		38						
2003 Mean(SE)			**71(4)**	**151(8)**	**211(4)**	**247(1)**	**269(4)**	**285(0)**
South Dakota(SE)			86(2)	145(4)	190(5)	220(5)	242(8)	

LITERATURE CITED

Francis, J. 1999. Winfin, Version 2.95; Microsoft Access Program for data entry. Nebraska Game and Parks Commission, Lincoln.

Francis, J. 2000. WinFin Analysis Program. Version 1.5. Nebraska Game and Parks Commission, Lincoln.

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RECOMMENDATIONS

1. Survey largemouth bass population when water levels allow.

APPENDICES

Appendix A. Stocking record for Rabbit Creek Dam, Harding County 1978-2003.

Year	Number	Species	Size
1978	50	Black crappie	ADT
	500	Largemouth bass	FGL
1982	1000	Largemouth bass	FGL
1999	350	Rainbow trout	FGL
2001	1400	Rainbow trout	FGL

Appendix B. Water chemistry results from Rabbit Creek Dam, Harding Co., June 23, 2003.

Depth (ft)	Temp (°C)	D.O. (mg/l)	pH	Conductivity (*u*mhos/cm)	Secchi disk (ft)
Surface	22.0	5.2	9.9		2
2	22.0	5.2			
4	22.0	5.0			
6	22.0	4.8			
8	20.0	4.4			
10	20.0	2.6			
12	20.0	1.8			

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-36

Name: Bear Butte Lake County(ies): Meade
Legal description: T 6 N, R 7 E, Sec. 25 & 30
Location from nearest town: 4 mi. W, 2.5 mi. N of Sturgis, SD
Dates of present survey: May 21-22, 2003
Date last surveyed: May 17-18, 1999
Most recent lake management plan: F21-R-31 Date: 1998
Management classification: Warmwater semi-permanent
Contour mapped: Date 1972

Primary Species:(game and forage)	Secondary and other species:
1. Largemouth bass	1. Green sunfish
2. Yellow perch	2. Fathead minnow
3. Black crappie	3. Rock bass
4. Northern pike	4. Black Bullhead

PHYSICAL CHARACTERISTICS

Surface Area: 180 acres; Watershed: 2,000 acres
Maximum depth: 13 feet; Mean depth: 7 feet
Lake elevation at survey (from known benchmark): - 4 feet

1. Describe ownership of lake and adjacent lakeshore property:

The lake and lakeshore are owned by the South Dakota Department of Game, Fish and Parks. Bear Butte State Park manages the lakeshore property adjacent to the lake.

2. Describe watershed condition and percentages of land use:

The Bear Butte Lake watershed is predominately grassland. The small size of the watershed affects the overall water level on a seasonal basis. Drought conditions have impacted Bear Butte severely with a maximum depth at the time of this survey of 7 feet.

3. Describe aquatic vegetative condition:

No emergent vegetation was present at the time of this survey, due to falling water levels. Submerged vegetation is excessive from mid summer to freeze up.

4. Describe pollution problems:

No pollution problems were identified by departmental personnel during the survey.

5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:

The boat ramp is in fair condition. At the time of this survey the boat ramp was barely usable due to low water levels.

CHEMICAL DATA

1. Describe general water quality characteristics.

Water chemistry parameters were collected on May 30, 2003 at an established station. Field measurements included temperature and dissolved oxygen profile, surface pH, surface conductivity and transparency (Appendix B).

2. Thermocline: No

3. Secchi disc reading: 2.0 ft

4. Stations for water chemistry located on attached lake map: Yes

BIOLOGICAL DATA

Methods

Sampling at Bear Butte Lake consisted of four; 3/4 inch frame nets and one 150 foot experimental gill net set for one night on May 21, 2003. All gill nets were monofilament experimental nets. Each net was 45.7-m (150-ft) long and 1.8-m (6-ft) deep with six 7.6-m (25-ft) panels of bar mesh sizes: 12.7-mm (0.5-in), 19.1-mm (0.75-in), 25.4-mm (1.0-in), 31.8-mm (1.25-in), 38.1-mm (1.5-in), and 50.8-mm (2.0-in). Trap nets were set at four stations consisting of one net night each. All trap nets were modified fyke-nets with a 1.3-X 1.5-m frame, 19.1-mm (0.75-in) mesh and a 1.2- X 23-m (3.9- X 75.5-ft) lead. Collected fish were measured for total length (TL; mm) and weighed (g). Only fish from the gill net were weighed. In addition, scale samples for the first five fish per centimeter group were collected from selected fish per gear type for age and growth analysis. Scale samples were pressed onto acetate slides and viewed with a microfiche projector (40X) and the distance between scale annuli were recorded on paper strips. All data was entered into WinFin 2.95 (Francis 1999).

Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch-per-unit-effort (CPUE), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr) based on length categories. Abundance was expressed as the mean catch-per-unit-effort (CPUE; mean number per net night or mean number per hour of electrofishing). Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr.

Results and Discussion

Bear Butte Lake is dominated by small black crappie. Crappie comprised 76% of the frame net catch and 58% of the gill net catch. Black bullheads were second most abundant comprising 22% of the gill net and frame net catch. Population parameters of dominant game and forage species in Bear Butte Lake are discussed individually below.

Table 1. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock-length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD-P; 90% CI's in parentheses), for all fish species collected from four, ¾ inch frame nets in Bear Butte Lake, May 21, 2003.

Species	N	CPUE	CPUE-S	PSD	RSD-P
BLB	156	39.0(19.5)	--	97(4)	--
BLC	543	135.8(88.7)	--	--	--
BLG	4	1.0(1.2)	0.3(0.4)	0	0
LMB	1	0.3(0.4)	0.3(0.4)	--	--
NOP	10	2.5(0.5)	1.8	14(28)	0
WHS	1	0.3(0.4)	0.3(0.4)	--	--
YEP	3	0.8(1.2)	0.8(1.2)	--	--
total	718				

Table 2. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD-P; 90% CI's in parentheses), and condition factor (Wr for fish ≥ stock length; 80%CI's) for all fish species collected from a 150-ft experimental sinking gill net in Bear Butte Lake, May 21, 2003.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr ≥ S
BLB	23	23.0	23.0	100(--)	0(--)	86.9(1.3)
BLC	60	60.0	60.0	72(10)	0(--)	87.2(0.1)
NOP	10	10.0	10.0	40(30)	0(--)	95.0(4.9)
YEP	10	10.0	10.0	80(24)	10(18)	77.2(2.6)
Total	103					

Black Bullhead

Black bullhead numbers have decreased substantially since the 1999 survey, when frame net CPUE was 147.0. This survey had a frame net CPUE of 39.0 and our single gill net captured 23 bullheads. No gillnet were set during the 1999 survey to compare with the 2003 catch. The length frequency histogram shows no small bullheads, indicating poor recruitment in recent years (Figure 1).

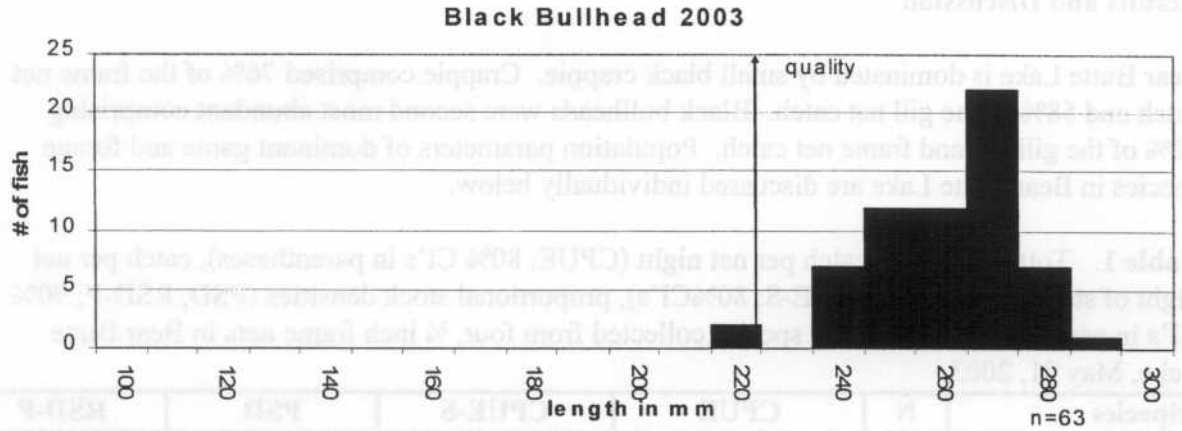

Figure 1. Length frequency histogram for black bullheads sampled from the gillnet in Bear Butte Lake, May 21, 2003

Black Crappie

The crappie population remains similar to what it was in 1999, when a frame net CPUE of 147 was recorded. In 2003, CPUE was 135.8 (Table 1). The gill net sample yielded a PSD of 72 and an RSD-P of 0 (Table 2). Fish condition was below average with a mean Wr for stock length and larger fish of 82.9. No fish were sampled over 220 millimeters (Figure 2).

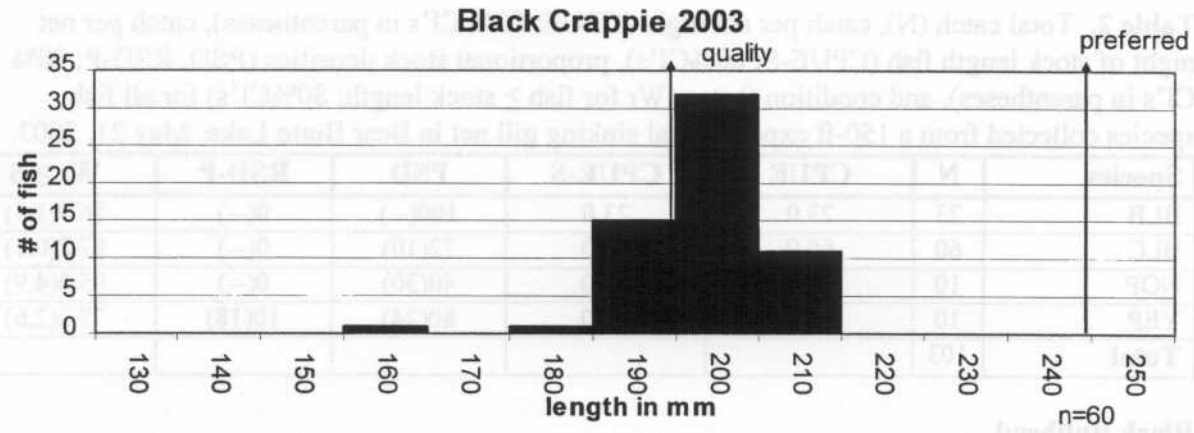

Figure 2. Length frequency histogram for black crappie sampled from the gillnet in Bear Butte Lake, May 21, 2003.

Northern Pike

In efforts to increase predation on crappies and bullheads while enhancing the pike population, which had been negatively effected by years of low water, Bear Butte Lake was stocked with 735 adult northern pike (Appendix A). These fish averaged 1.5 pounds. This huge stocking showed up in our survey with a gill net CPUE of 10.0 and a frame net CPUE of 2.5. In 1999, frame net CPUE was 0.6.

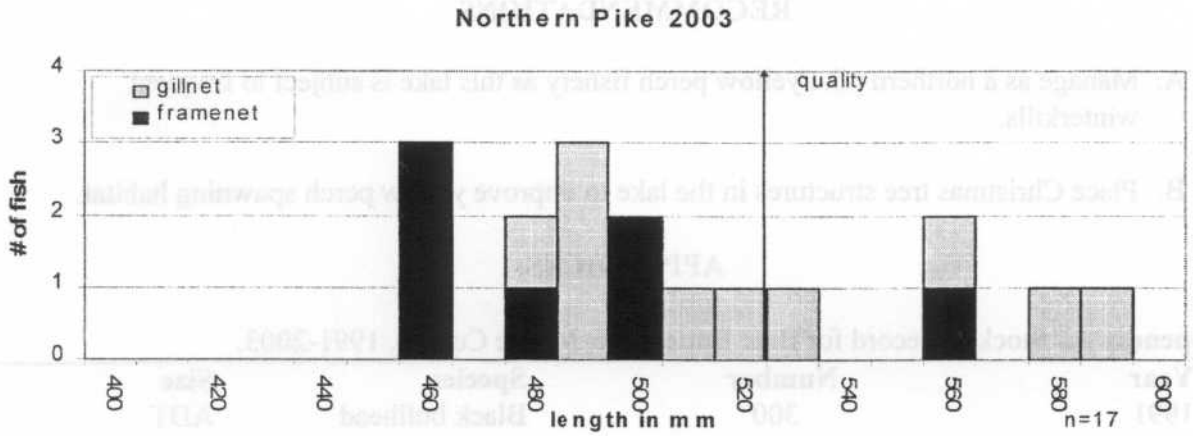

Figure 3. Length frequency histogram for northern pike sampled from the frame nets and gillnet in Bear Butte Lake, May 21, 2003.

Yellow Perch

Even with low water and little spawning habitat, Bear Butte Lake maintains a low density perch population. The gill net caught 10 perch while the frame net CPUE was 0.8. In 1999, frame net CPUE was 2.2. Though the sample size was small, it appears perch are able to reach a size preferred by anglers even with all the black crappie competition (Figure 4).

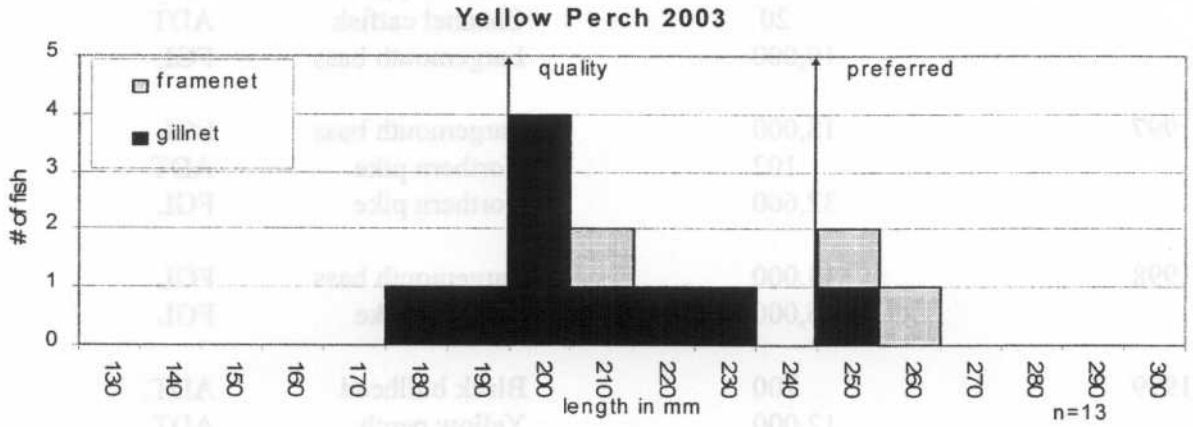

Figure 4. Length frequency histogram for yellow perch sampled from the frame nets and gillnet in Bear Butte Lake, May 21, 2003.

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RECOMMENDATIONS

A. Manage as a northern pike/yellow perch fishery as this lake is subject to frequent winterkills.

B. Place Christmas tree structures in the lake to improve yellow perch spawning habitat.

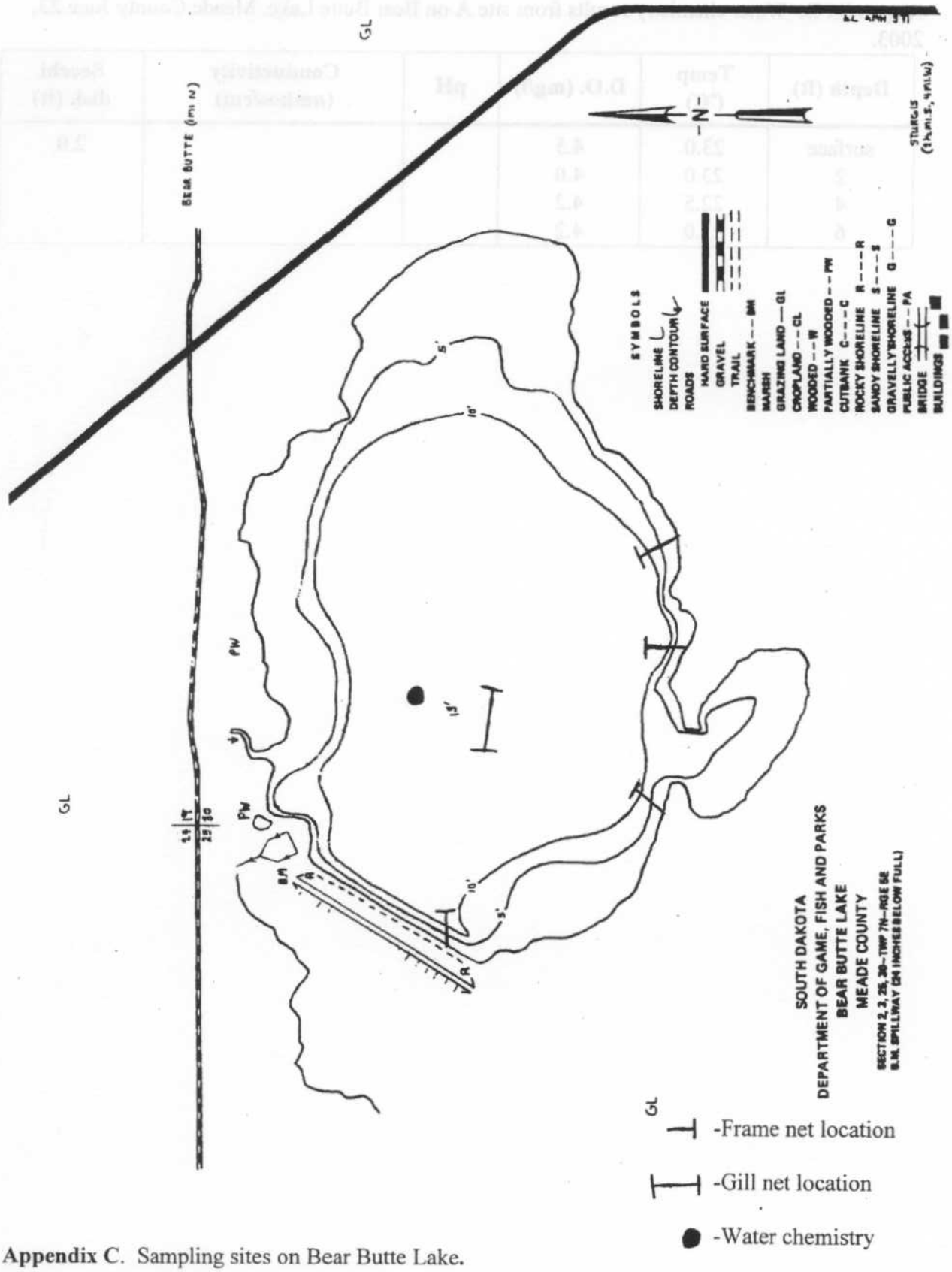
APPENDICES

Appendix A. Stocking record for Bear Butte Lake, Meade County, 1991-2003.

Year	Number	Species	Size
1991	300	Black bullhead	ADT
1995	1,327	Black bullhead	ADT
	1,657	Black crappie	ADT
	17	Bluegill	ADT
	463	Channel catfish	ADT
	11,970	Largemouth bass	FGL
	100	Yellow perch	ADT
1996	235	Northern pike	ADT
	1,110	Black crappie	ADT
	20	Channel catfish	ADT
	10,000	Largemouth bass	FGL
1997	18,000	Largemouth bass	FGL
	102	Northern pike	ADT
	32,600	Northern pike	FGL
1998	13,000	Largemouth bass	FGL
	36,000	Northern pike	FGL
1999	700	Black bullhead	ADT
	12,000	Yellow perch	ADT
	9,750	Largemouth bass	FGL
2000	16,000	Largemouth bass	FGL
2002	12,500	Largemouth bass	FGL
2003	735	Northern pike	ADT

Appendix B. Water chemistry results from site A on Bear Butte Lake, Meade County June 23, 2003.

Depth (ft)	Temp (°C)	D.O. (mg/l)	pH	Conductivity (*u*mhos/cm)	Secchi disk (ft)
surface	23.0	4.5			2.0
2	23.0	4.0			
4	22.5	4.2			
6	22.0	4.2			



Appendix C. Sampling sites on Bear Butte Lake.

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-36

Name: Curlew Lake County: Meade
Legal description: T 3N, R 11E Sec. 2, 10, 11
Location from nearest town: 8 mi. N, 4 mi. E, 1.5 mi. N of New Underwood, SD
Dates of present survey: June 9-11, 2003; September 19, 2003
Date last surveyed: July 5, 2000; July 31 -August 2, 2000; October 25, 2000
Most recent lake management plan: F21-R-30 Date: 1998
Management classification: Warmwater permanent
Contour mapped: Date July 1994

Primary Species: (game and forage)
1. Black crappie
2. Largemouth bass
3. Northern pike
4. Walleye

Secondary and other species:
1. Bluegill
2. Yellow perch

PHYSICAL CHARACTERISTICS

Surface Area: 136 acres; Watershed: 12,800 acres
Maximum depth: 22 feet; Mean depth: 10.2 feet
Lake elevation at survey (from known benchmark): -2.5 feet

1. Describe ownership of lake and adjacent lakeshore property:

Curlew Lake is owned and managed by the Department of Game, Fish and Parks. All land bordering the immediate shoreline, excluding three quarter sections in Section 2 and a small tract of land comprising 10 acres in Section 11, are owned by South Dakota Department of Game, Fish and Parks. The 10-acre tract in Section 11 has a written access agreement with the landowner; the three quarter sections in Section 2 do not have active access agreements. There is no record of problems regarding public access across this section of land.

2. Describe watershed condition and percentages of land use:

Curlew Lake watershed is comprised of 80% range and pasture lands and 20% cropland.

3. Describe aquatic vegetative condition:

Rooted aquatic vegetation appears along most of the shoreline. Bulrush is the primary emergent plant species associated with the lake. Coontail and grassy pondweed are abundant submersed vegetative species in the lake.

4. Describe pollution problems:

Department personnel identified no pollution problems during the 2003 survey.

5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:

All access and regulatory structures appear to be in adequate condition.

CHEMICAL DATA

1. Describe general water quality characteristics.

Values for dissolved oxygen and temperature were measured using a YSI Model 57 Dissolved Oxygen Meter and are presented in Appendix B.

2. Thermocline: No

3. Secchi disc reading: 6.0 ft

4. Stations for water chemistry located on attached lake map: Yes

BIOLOGICAL DATA

Methods

Fish Community Survey

A lake survey was conducted on June 9-11, 2003. Sampling consisted of 2 gill net nights and 6 trap net nights (Appendix C). All gill nets were monofilament experimental nets. Each net was 45.7-m (150-ft) long and 1.8-m (6-ft) deep with six 7.6-m (25-ft) panels of bar mesh sizes: 12.7-mm (0.5-in), 19.1-mm (0.75-in), 25.4-mm (1.0-in), 31.8-mm (1.25-in), 38.1-mm (1.5-in), and 50.8-mm (2.0-in). Trap nets were set at four stations consisting of two nights per station. Two of our trap nets were pulled up on shore the second day with all fish being removed. Obviously, these nets were thrown out of the data set. All trap nets were modified fyke-nets with a 1.3-X 1.5-m frame, 19.1-mm (0.75-inch) mesh and a 1.2- X 23-m (3.9- X 75.5-ft) lead. Collected fish were measured for total length (TL; mm) and weighed (g). In addition, scale samples for the first five fish per centimeter group were collected from selected fish per gear type for age and growth analysis. Scale samples were pressed onto acetate slides and viewed with a microfiche projector (40X) and the distance between scale annuli were recorded on paper strips. All data was entered into WinFin 2.95 (Francis 1999).

Night electrofishing was conducted at Curlew Lake on September 19, 2003. Electrofishing was conducted using a Smith- Root control unit with pulsed-DC. Six, ten-minute stations were completed during the survey. All largemouth bass were collected, measured for total length (TL;

mm) and weighed (g). In addition, scale samples were collected from up to 5 fish per centimeter group for age and growth analysis. All data was entered into WinFin 2.95.

Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch-per-unit-effort (CPUE), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr) based on length categories. Abundance was expressed as the mean catch-per-unit-effort (CPUE; mean number per net night or mean number per hour of electrofishing). Actual pedal time (time the electrofishing unit produced current) was recorded from the digital display on the control box and used to calculate electrofishing CPUE. Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr.

Results and Discussion

Curlew Lake is an important coolwater fishery located about thirty minutes from Rapid City. It is a favorite location for many Rapid City anglers in search of walleye, largemouth bass, black crappie and other panfish species. During this survey 885 individual panfish (black crappie, black bullhead, bluegill and yellow perch) were sampled, of these, only four black crappies were over a length preferred by anglers. In efforts to improve panfish quality and walleye catch rates, a 14-inch minimum length limit will be imposed on walleye starting in 2004. Curlew is also scheduled to receive biannual stockings of large, fall walleye fingerlings. These two management strategies should help improve this valuable fishery.

Fish Community Survey

Gillnet and Trapnet Survey

Overall, nine fish species were collected during the lake survey conducted June 9-11, 2003 in Curlew (Tables 1 and 2). Seven hundred eighty four fish were collected in frame nets, with black crappie comprising 77% of the total. Black bullheads were the second most abundant species in the frame nets with 18%. Other species sampled, in order of abundance, were bluegill, yellow perch, common carp, walleye and northern pike. The gillnet catch was dominated by yellow perch, and black crappie which comprised 52% and 21% of the total catch, respectively. Other species sampled in the gill nets include walleye, northern pike, black bullhead, white sucker and channel catfish. Population parameters of the dominant game fish species in Curlew are discussed individually below.

Fall electrofishing survey

Six, ten-minute stations of electrofishing captured 156 largemouth bass in 3600 seconds of pedal time on 9/19/03 (Table5). Largemouth bass were the only fish targeted by this survey.

Table 1. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock-length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD-P; 90% CI's in parentheses), and condition factor (Wr for fish ≥ stock length; 80%CI's) for all fish species collected from six ¾ inch trapnets in Curlew Lake, Meade County, June 9-11, 2003

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr ≥ S
Black Bullhead	141	23.5(10.6)	23.5(10.6)	91(4)	0	82.4(1.7)
Black Crappie	607	101.2(95.4)	101.2(95.4)	79(3)	1(1)	93.3(0.7)
Bluegill	18	3.0(3.0)	3.0(3.0)	61(21)	0	102.9(1.2)
Common Carp	2	0.3(0.5)	0.3(0.5)	--	--	97.0(13.9)
Northern Pike	1	0.2(0.2)	0.2(0.2)	--	--	80.8(--)
Walleye	2	0.3(0.5)	0.3(0.5)	--	--	84.0(17.4)
Yellow Perch	13	2.2(1.4)	2.2(1.4)	15(19)	0	84.1(3.2)
total	784					

Table 2. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD-P; 90% CI's in parentheses), and condition factor (Wr for fish ≥ stock length; 80%CI's) for all fish species collected from two, 150-ft experimental sinking gill nets in Curlew Lake, Meade County, June 9-11, 2003

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr ≥ S
Black Bullhead	2	1.0(3.1)	1.0(3.1)	--	--	--
Black Crappie	21	10.5(26.2)	10.0(27.7)	70(18)	0	96.1(1.8)
Channel Catfish	1	0.5(1.5)	0.5(1.5)	--	--	106.1(--)
Northern Pike	8	4.0(6.2)	4.0(6.2)	75(31)	25(31)	90.7(5.0)
Walleye	14	7.0(21.5)	6.0(18.5)	33(26)	0	83.6(4.8)
White Sucker	2	1.0(3.1)	1.0(3.1)	--	--	101.1(6.1)
Yellow Perch	53	26.5(20)	25.5(16.9)	2(3)	0	83.8(0.5)
Total	101					

Black bullhead

CPUE of bullheads in trap nets from Curlew increased from 5 in 2000 to 23.5 in 2003. CPUE in gill nets, however, decreased dramatically from 50 in 2000 to 1.0 this survey. All fish captured ranged from 210 to 270 mm (Figure 1). PSD increased from 24 last survey to 91 in 2003. The absence of bullheads smaller than 8 inches may be a sign of preference for small bullheads by the large bass population. There were no bullheads over preferred length in either of the last two surveys. Condition of black bullheads in Curlew Lake is fair. Mean relative weights (Wr) for stock length and larger bullheads was 82.4 (Table 1). These fish may be having a hard time reaching larger sizes, because of competition with the many other species in Curlew.

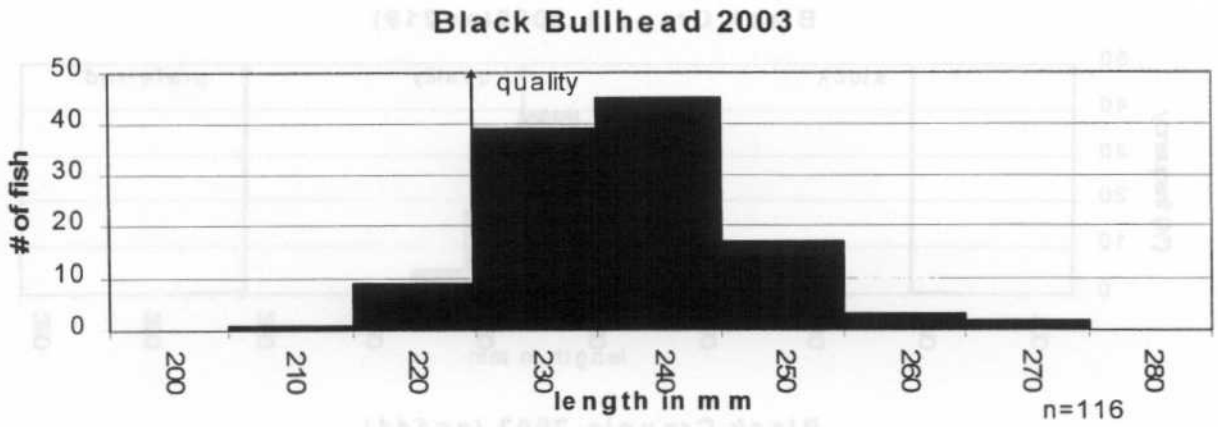


Figure 1. Length frequency histogram of black bullhead from frame nets at Curlew Lake 6/10/2003.

Black Crappie

Curlew's fish population was dominated by black crappie with a frame net CPUE of 101.2 (Table 1). All fish sampled were over stock length (Figure 2). PSD was 79 with an RSD-P of 1 (Table 1). Fish condition was average with a Wr for stock length and larger fish of 93.3 (Table 1). These numbers were similar to the 2000 survey when CPUE was 120 and mean Wr was 92. In 2000, PSD was 26 with an RSD-P of 0. Growth was similar to 2000 and slower than the state average (Table 3).

Table 3. Curlew lake black crappie year class, age in 2003, sample size (N), mean back-calculated total length at age, population standard error (SE), the 2000 mean length at age, and the South Dakota bluegill mean length at age (Willis et al. 2001).

Year Class	Age	N	Age 1	2	3	4	5	6
2001	2	7	79	125				
2000	3	15	70	139	183			
1999	4	11	75	134	175	202		
1998	5	10	71	140	175	198	215	
1997	6	1	69	132	197	210	225	242
Sample size		44						
mean(SE)			**73(2)**	**134(3)**	**183(5)**	**203(4)**	**220(5)**	**242(0)**
2000 mean			75(3)	127(3)	173(5)	199(1)	217(0)	226(0)
SD mean			83(2)	147(4)	195(5)	229(6)	249(6)	

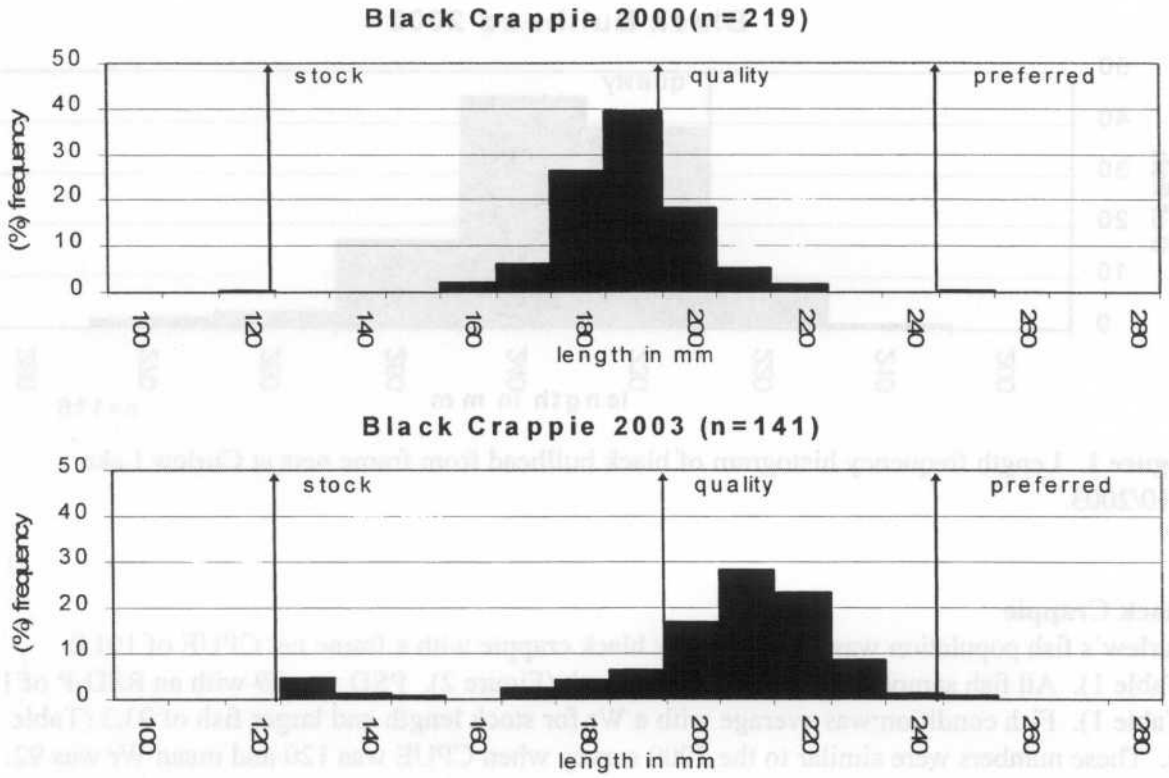


Figure 2. Length frequency histogram of black crappie from frame nets at Curlew Lake from 2000-2003

Bluegill

Catch of bluegill from Curlew Lake remains low. Eight adults were collected in trap nets during 2000 for a CPUE of 1.0. The 2003 survey CPUE was 3.0 (Table 1). PSD was 61 with an RSD-P of 0. Fish condition was excellent with a Wr for stock length and greater fish of 102.9. Fish growth was slower than the statewide average (Table 4).

Table 4. Curlew lake bluegill year class, age in 2003, sample size (N), mean back-calculated total length at age, population standard error (SE), and the South Dakota bluegill mean length at age (Willis et al. 2001).

Year Class	Age	N	Age 1	2	3	4	5
2001	2	3	45	89			
2000	3	4	37	86	121		
1999	4	8	44	80	121	154	
1998	5	2	37	84	114	143	173
Sample size		17					
mean(SE)			**41(2)**	**85(2)**	**119(2)**	**148(5)**	**173(0)**
SD mean			55(2)	103(3)	141(3)	166(4)	180(4)

Largemouth bass

Largemouth bass were only species collected during nighttime electrofishing. A total of 156 fish were collected in six, ten-minute run (Table 5). **Bass** density was excellent with a CPUE for stock length and larger bass of 46.0, the highest recorded in recent history. CPUE for all bass was 156.0, showing a huge number of substock fish (age-1). Stock indices would indicate a balanced population with a PSD of 41 and an **RSD-P** of 15 (Willis et al. 1993). Fish condition remains excellent with mean Wr for stock length and larger bass of 113.2 (Table 5). In 2001, CPUE for stock length and larger fish was 15.8, PSD was 77 with an RSD-P of 3. Fish growth was excellent, above the 2001 mean and the state average (Table 6). Length frequency histograms show excellent bass recruitment in recent years (Figure 3). Curlew appears to have and excellent bass population with good growth and recruitment. The strong 2002 year class should help reduce crappie recruitment, if angler harvest is not too excessive.

Table 5. Total catch (N), pedal time (seconds), catch per hour of electrofishing (CPUE), mean total length (TL, standard error is given in parentheses), proportional stock densities (PSD, RSD; 90% confidence intervals are given in parentheses) and condition factor (Wr for fish ≥ stock length; 80%CI's) for largemouth bass collected by electrofishing in Curlew Lake, 2000-2003.

Year	N	Pedal Time (sec)	CPUE	CPUE-S	PSD	RSD-P	Wr≥S
2000	54	7202	27.0	25.0	58(12)	24(10)	114.4(3.8)
2001	64	7909	29.9(6.4)	15.8(5.1)	77(12)	3(5)	114.7(2.0)
2003	156	3600	156.0(28.7)	46.0(16.6)	41(13)	15(9)	113.2(1.0)

Table 6. Curlew Lake largemouth bass year class, age in 2003, sample size (N), mean back-calculated total length at age, population mean and standard error (SE), mean length at age in 2001, and the South Dakota largemouth bass mean length at age (Willis et al. 2001).

Year			Age					
Class	Age	N	1	2	3	4	5	6
2002	1	40	69					
2001	2	24	89	212				
2000	3	5	112	232	304			
1999	4	3	85	181	277	335		
1998	5	3	73	198	270	326	368	
1997	6	1	76	181	255	293	328	362
total		76						
mean(SE)			**84(6)**	**201(10)**	**277(10)**	**318(13)**	**348(20)**	**362(0)**
2001			80(4)	170(8)	236(17)	279(20)	311(33)	340(44)
S.D. Mean			96(3)	182(6)	250(7)	305(8)	342(8)	

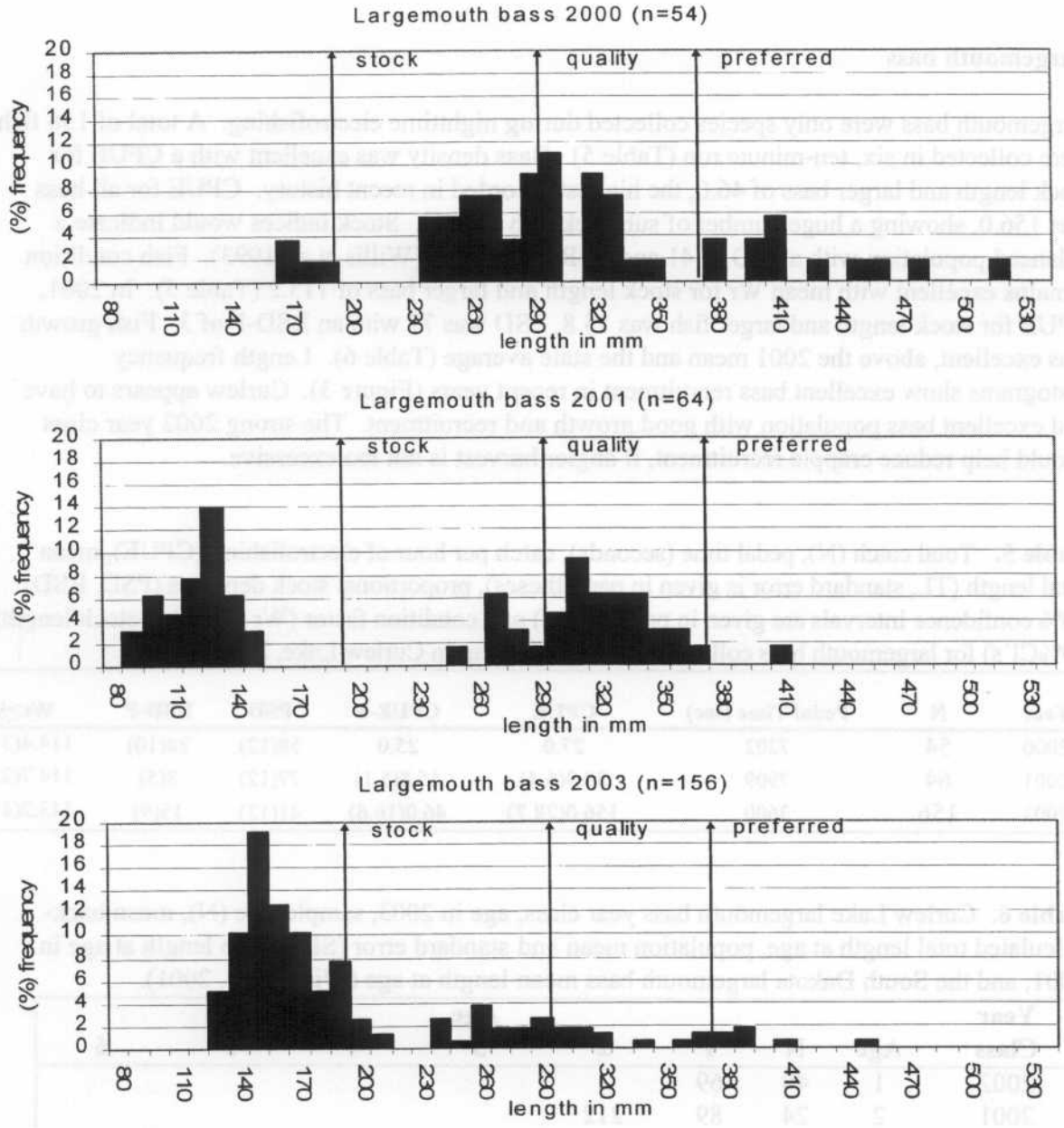


Figure 3. Length frequency histograms for largemouth from night electrofishing in Curlew Lake, 2000-2003.

Walleye

In hopes of establishing a more quality panfishery at Curlew, walleye density needs to improve. Gillnet CPUE was 7.0 and CPUE greater than stock length was 6.0 (Table 2). In the fall of 2003, 2,174 walleye fingerlings were stocked. These fish averaged ten inches in length. With the addition of a 14 inch minimum, walleye should become an excellent second predator. Some natural reproduction has occurred as no walleye were stocked between 1993 and 2001, yet fish in

these year classes are evident in the length frequency histogram (Figure 4). It appears that the 2001 fingerling stocking has been recruited to the population as 10 of the 14 aged walleye were two year olds (Table 7).

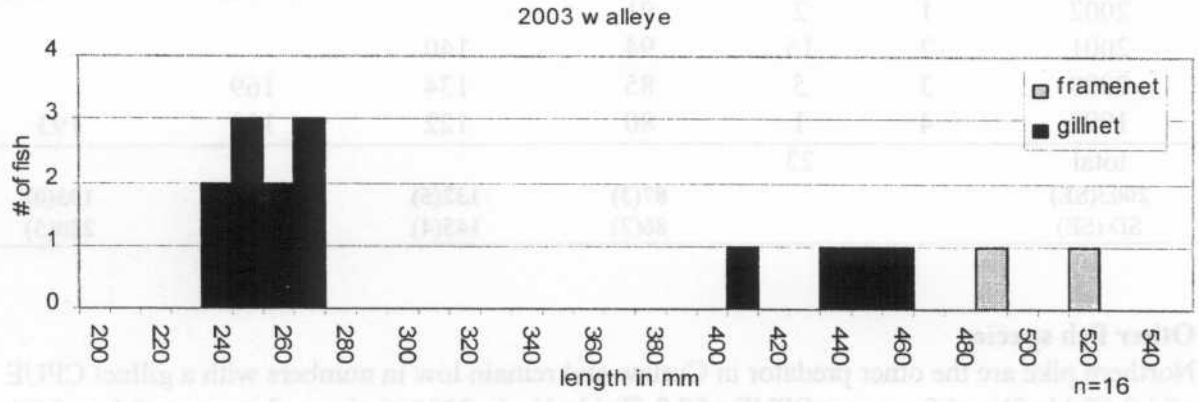


Figure 4. Length frequency for walleye from gillnet and framenet catch in Curlew Lake, 2003.

Table 7. Curlew Lake walleye age in 2003, sample size (N), mean back-calculated total length at age, population standard error (SE).

Year Class	Age	N	Age 1	2	3	4	5	6	7
2001	2	10	126	244					
1998	5	2	133	231	297	366	413		
1997	6	1	127	219	323	385	424	453	
1996	7	1	120	180	238	306	362	405	436
total		**14**							
Mean(SE)			**127(3)**	**219(14)**	**286(25)**	**352(24)**	**400(19)**	**429(24)**	**436(0)**

Yellow Perch

Perch density has increased since 2000 when only two perch were sampled in the gillnet. This survey had a CPUE of 26.5 of which 25.5 were of greater than stock length (Table 2). Size structure was small with a PSD of 2 and an RSD-P of 0. Fish condition was also low with a Wr for stock length and greater fish of 83.8. As expected, growth was slow. By age 4 perch were one year behind the state average (Table 8). The perch population seems to be outcompeted by the bluegill and black crappie populations.

Table 8. Curlew Lake yellow perch age in 2003, sample size (N), mean back-calculated total length at age, population standard error (SE).

Year Class	Age	N	Age 1	2	3	4
2002	1	2	91			
2001	2	15	94	140		
2000	3	5	85	134	169	
1999	4	1	80	122	152	193
total		23				
2003(SE)			**87(3)**	**132(5)**	**161(8)**	**193(0)**
SD (SE)			86(2)	145(4)	190(5)	220(5)

Other fish species

Northern pike are the other predator in Curlew and remain low in numbers with a gillnet CPUE of 4.0 (Table 2) and frame net CPUE of 0.2 (Table 1). In 2000, their numbers were 3.0 and 0.1, respectively. Other species caught include; one large channel catfish and two white suckers in the gill nets, and two common carp in the frame nets.

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Willis, D.W., D.A. Isermann, M.J. Hubers, B.A. Johnson, W.H. Miller, T.R. St. Sauver, J.S. Sorenson, E.G. Unkenholz, and G.A. Wickstrom. 2001. Growth of South Dakota Fishes

RECOMMENDATIONS

1. Continue to stock large walleye fingerling every other year as a second predator.
2. Electrofish annually to get better data sets on walleye and largemouth bass.
3. Survey panfish populations every other year to document effects of the new management strategies.

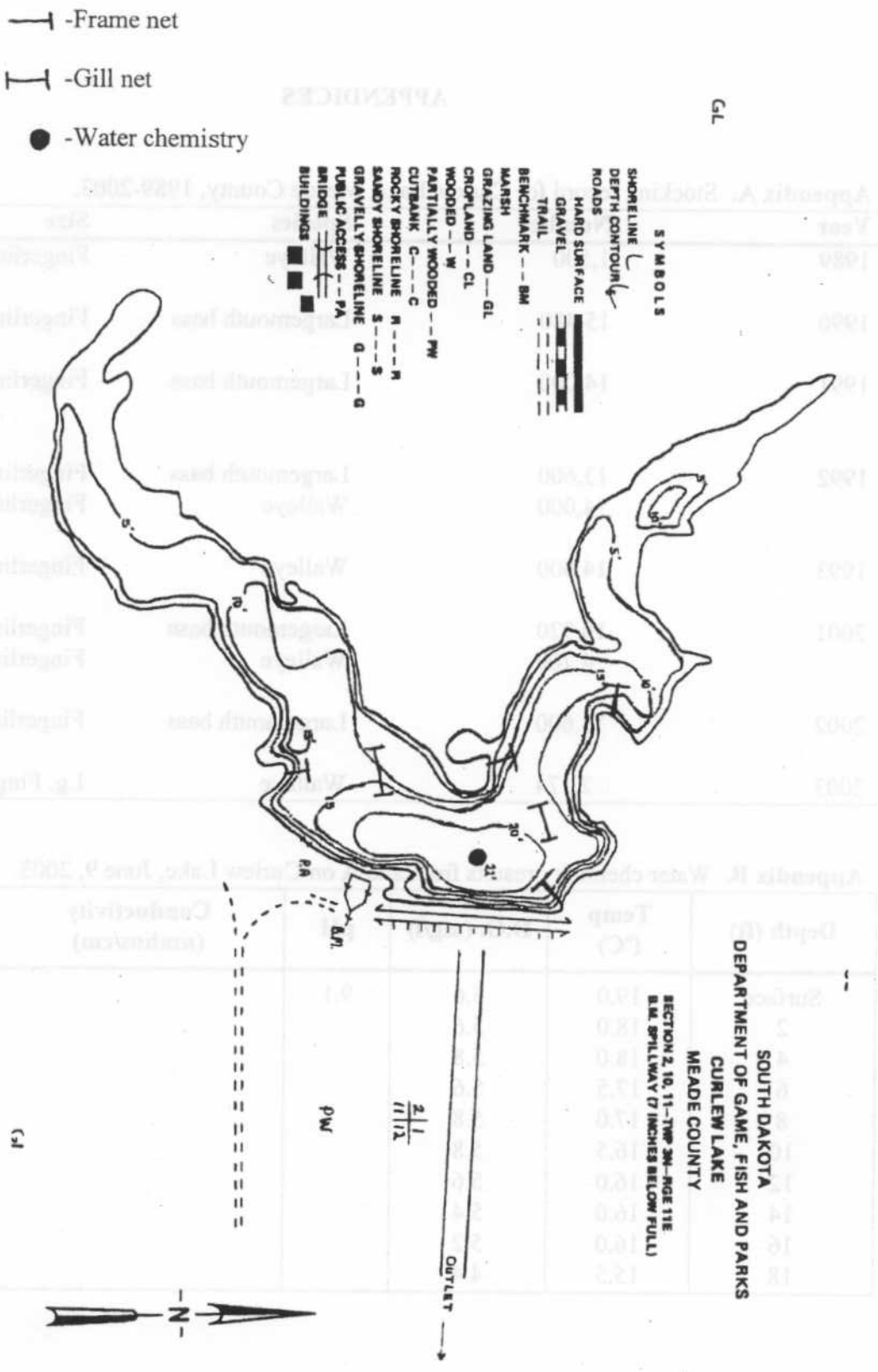
APPENDICES

Appendix A. Stocking record for Curlew Lake, Meade County, 1989-2003.

Year	Number	Species	Size
1989	1,500	Walleye	Fingerling
1990	15,480	Largemouth bass	Fingerling
1991	14,000	Largemouth bass	Fingerling
1992	13,600	Largemouth bass	Fingerling
	14,000	Walleye	Fingerling
1993	14,000	Walleye	Fingerling
2001	10,920	Largemouth bass	Fingerling
	4,760	Walleye	Fingerling
2002	13,600	Largemouth bass	Fingerling
2003	2,174	Walleye	Lg. Fingerling

Appendix B. Water chemistry results from site A on Curlew Lake, June 9, 2003.

Depth (ft)	Temp (°C)	D.O. (mg/l)	pH	Conductivity (*u*mhos/cm)	Secchi disk (ft)
Surface	19.0	5.6	9.1		6
2	18.0	5.6			
4	18.0	5.8			
6	17.5	5.6			
8	17.0	5.8			
10	16.5	5.8			
12	16.0	5.6			
14	16.0	5.4			
16	16.0	5.2			
18	15.5	4.4			



Appendix C. Sampling sites at Curlew Lake.

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-36

Name: Opal Lake County(ies): Meade
Legal description: Sec. 16, Twn. 11 N, R 14 E
Location from nearest town: 17 miles west, 9 miles south of Faith, SD
Dates of present survey: June 11-13; October 2, 2003
Date last surveyed: October 1, 2001
Most recent lake management plan: F21-R-32 Date: 2000
Management classification: Warmwater permanent
Contour mapped: Date 1995

Primary Species:(game and forage)	Secondary and other species:
1. Yellow perch	1. Largemouth bass
2. Northern pike	2. Black bullhead
3. Bluegill	3.

PHYSICAL CHARACTERISTICS

Surface Area:31.3 acres; Watershed:4,500 acres
Maximum depth:18 feet; Mean depth:7.5 feet
Lake elevation at survey (from known benchmark): -5 feet

1. Describe ownership of lake and adjacent lakeshore property:

Opal Dam is situated on 200 acres of Game Production Area owned and managed by the South Dakota Department of Game, Fish and Parks. Ten acres of trees were planted within the GPA during 1993. The entire acreage is fenced with an autogate for access. Access to the GPA is provided along a section line trail. Access is restricted to fair weather, the road will be impossible in wet periods.

2. Describe watershed condition and percentages of land use:

The watershed of Opal Dam is almost entirely used for livestock grazing, some of the watershed is planted into small grain.

3. Describe aquatic vegetative condition:

During the summer, vast areas of submergent vegetation (coontail, buttercup, potomogeton) are along the shoreline. Except for the riprap of the dam, emergent vegetation (cattails and reeds) surrounds much of the lake. Shoreline angling is hampered in mid summer to late fall because of vegetation.

4. Describe pollution problems:

Department personnel identified no pollution problems during the 2003 survey.

5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:

Opal Dam has a new spillway (installed in 1994) and a new boat ramp.

CHEMICAL DATA

1. Describe general water quality characteristics.

Water chemistry parameters were collected on June 12, 2003 at 1 established station. Field measurements included temperature and dissolved oxygen profile, surface pH, and transparency (Appendix B).

2. Thermocline: No

3. Secchi disc reading: 9 feet

4. Stations for water chemistry located on attached lake map: Yes

BIOLOGICAL DATA

Methods

A lake survey was conducted on Opal on June 11-13, 2003. Sampling consisted of one gill net nights and 4 trap net nights (Appendix C). The gill net was a monofilament experimental net 45.7 m (150-ft) long and 1.8 m (6-ft) deep with six 7.6 m (25-ft) panels of bar mesh sizes: 12.7 mm (0.5 in), 19.1 mm (0.75 in), 25.4 mm (1.0 in), 31.8 mm (1.25 in), 38.1 mm (1.5 in), and 50.8 mm (2.0 in). All trap nets were modified fyke-nets with a 1.3 X 1.5-m frame, 19.1 mm (0.75 inch) mesh and a 1.2- X 23-m (3.9- X 75.5-ft) lead. Collected fish were measured for total length (TL; mm) and weighed (g). In addition, scale samples for the first five fish per centimeter group were collected from selected fish per gear type for age and growth analysis. Scale samples were pressed onto acetate slides and viewed with a microfiche projector (40X) and the distance between scale annuli were recorded on paper strips. All data was entered into WinFin 2.95 (Francis 1999).

Night electrofishing was conducted at Opal on October 2, 2003. Electrofishing was conducted using a Smith-Root unit with pulsed-DC. A total of five, 10 minute stations were sampled. All largemouth bass were collected, measured for total length (TL; mm) and weighed (g). In addition, scale samples were collected (Carlander 1982) from up to 5 fish per centimeter group for age and growth analysis. All data was entered into WinFin 2.95.

Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch per unit effort (CPUE), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr) based on length categories. Abundance was expressed as the mean catch per unit effort (CPUE; mean number per net night or mean number per hour of electrofishing). Actual pedal time (time the electrofishing unit produced current) was recorded from the digital display on the control box and used to calculate electrofishing CPUE. Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr.

Results and Discussion

Opal suffered from extremely low water levels in 2002 and 2003. During the summer sample the lake was four to five feet low. Our sample showed low density of large sized fish for bluegill, yellow perch, black bullhead and largemouth bass. Pike densities were higher but their size was smaller. It would appear they are the dominate predator keeping the other fish densities low. Heavy fall rains filled Opal completely by October I ' [t]. Acres of flooded grass and weeds were observed during fall electrofishing. This should help increases reproduction potential for most species in Opal. Fish indices for dominate species are discussed individually below.

Table 1. Total catch (N), catch per net night (CPUE), catch per net night of stock-length fish (CPUE-S), proportional stock-densities (PSD, RSD; 90% CI's in parentheses) and condition factor (mean Wr for stock length and larger fish) for all fish species from four frame nets in Opal Lake, Meade County, June 10-12, 2003.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr>S
Black bullhead	9	2.3(1.8)	2.3(1.8)	100(-)	0	93.8(3.2)
Bluegill	51	12.8(18.7)	12.8(18.7)	100(-)	98(3)	132.8(0.3)
Northern pike	13	3.3(3.7)	3.3(3.7)	8(13)	0	75.7(3.1)
Totals	73					

Table 2. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock-length fish (CPUE-S; 80% CI's in parentheses), proportional stock densities (PSD, RSD; 90% CI's in parentheses) and condition factor (mean Wr for stock-length and larger fish) for all fish species from one experimental gillnet in Opal Lake, Meade County, June 10-12, 2003.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr>S
Black bullhead	6	6.0	6.0	100	33(43)	109.9(6.1)
Northern pike	17	17.0	17.0	12(14)	6(10)	83.0(4.7)
Yellow perch	2	2.0	2.0	--	--	120.2(5.1)
Totals	25					

Table 3. Total catch (N), catch per hour of electrofishing (CPUE) with 80% CI in parentheses, catch per hour of stock-length fish (CPUE-S) with 80% CI in parentheses, proportional stock densities (PSD, RSD) with 90% confidence intervals given in parentheses and condition factor (mean Wr for stock-length and larger fish) for largemouth bass collected by night electrofishing in Opal Lake, Meade County, October 2, 2003.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr>S
LMB	6	7.2(6.8)	4.8(7.4)	100(--)	100(--)	115.4(1.4)
Total	6					

Black Bullhead

Opal appears to have a low density bullhead population. Our single gillnet caught 6 fish and our frame nets had a CPUE of 2.3. All fish sampled were over quality length indicating poor recruitment. Apparently the high abundance of small pike are keeping bullhead density low.

Bluegill

The biggest surprise of the 2003 survey was the extremely high quality bluegill population. Of the 51 fish sampled only one was under the preferred length of 8 inches (Figure 1). Density was low with a frame net CPUE of 12.8 (Table 1). Fish condition was unbelievable with a mean Wr for stock-length and larger fish of 132.8 (Table 1). As expected, growth was fast well above the state average (Table 4). It appears the high density of small pike are keeping bluegill densities low enough to create fast growth, excellent condition and size structure.

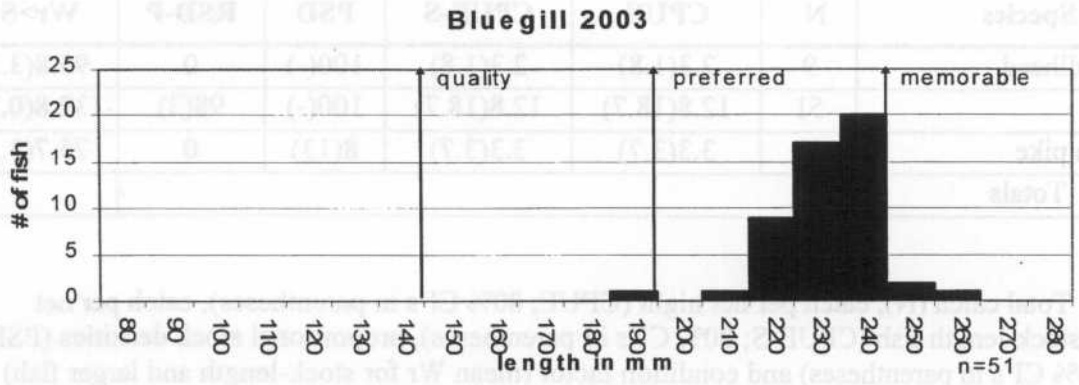


Figure 1. Length frequency histogram for bluegill from frame nets at Opal Lake, June 10-12, 2003.

Table 4. Bluegill at Opal year class, age in 2003, sample size (N), mean back-calculated total length at age, population standard error (SE), and the South Dakota bluegill mean length at age (Willis et al. 2001).

Year Class	Age	N	Age 1	2	3	4	5	6
2000	3	1	41	108	178			
1999	4	8	40	83	159	217		
1998	5	8	42	102	177	223	237	
1997	6	3	34	82	146	189	222	241
Sample size		20						
mean(SE)			**39(2)**	**94(7)**	**165(8)**	**210(10)**	**230(8)**	**241(0)**
SD mean			52(2)	103(3)	141(3)	166(4)	180(4)	

Largemouth Bass

Bass density remains extremely low in Opal with a CPUE for stock-length and larger bass of 4.8 (Table 3). This has not changed much since the last electrofishing survey in 2001, when CPUE-S was 6.0 (Table 5). All the newly flooded vegetation during the survey made electrofishing tough which may have affected catch rates.

Table 5. Total catch (N), catch per hour of electrofishing (CPUE) with 80% confidence intervals in parentheses, catch per hour of stock length fish (CPUE-S), and proportional stock densities (PSD, RSD) for largemouth bass collected by electrofishing in Opal Lake, Meade County, 1998-2003.

Year	N	CPUE	CPUE-S	PSD	RSD-P
1998	32	16.0		70	65
2001	124	111.8 (22.8)	6.0 (9.8)	100(--)	38(35)
2003	6	7.2(6.8)	4.8(7.4)	100(--)	100(--)

Northern Pike

Pike seem to be the fish responsible for the huge panfish in Opal. Density is fairly high with a gill net CPUE of 17 and a frame net CPUE of 3.3. Size structure was small with only four fish from the entire survey over quality length. Fish condition was low with a stock length and larger fish Wr of 83.0(Table 2). The lone, large pike (790mm) sampled, had a Wr of 109. A large run off event occurred in the fall of 2003 filling Opal completely. If the acres of flooded vegetation remain through spring, pike should have excellent reproduction.

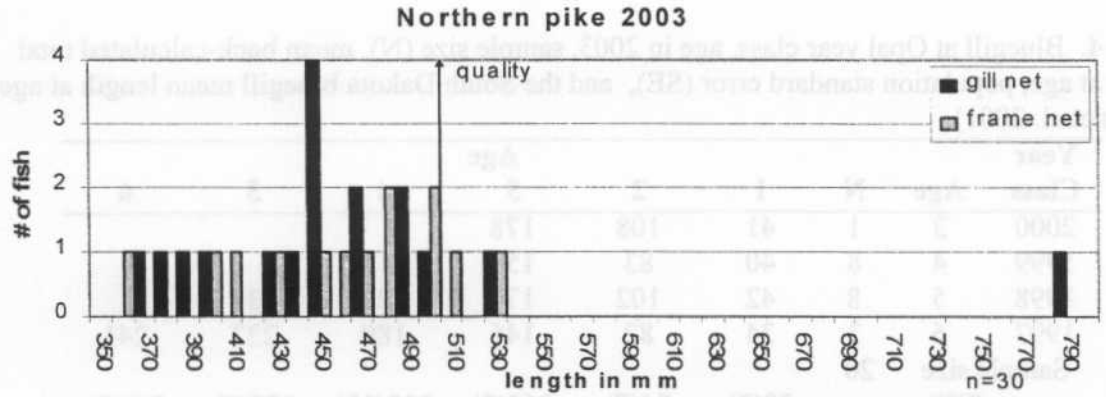


Figure 2. Length frequency histogram for northern pike from gill nets and frame nets at Opal Lake, June 10-12, 2003.

Yellow Perch

Only two perch were sampled in our single gillnet and none were seen in our frame net sample (Tables 1 &2). This indicates a low density population which hasn't been helped by years of low water. The two fish we did sample were in excellent condition with a Wr of 120.2 (Table 2). Both of these fish were over 13-inches in length. During fall electrofishing, several smaller perch were observed, indicating some other year classes in the lake. Hopefully, the newly flooded vegetation will help perch reproduction and recruitment this spring.

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Francis, J. 1999. WinFin: Version 2.95; Microsoft Access program for data entry. Nebraska Game and Parks Commission, Lincoln.

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Willis, D.W., D.A. Isermann, M.J. Hubers, B.A. Johnson, W.H. Miller, T.R. St. Sauver, J.S. Sorenson, E.G. Unkenholz, and G.A. Wickstrom. 2001. Growth of South Dakota Fishes: A Statewide Summary with means by region and Water Type. Special Report. South Dakota Department of Game, Fish and Parks. Pierre, South Dakota.

RECOMMENDATIONS

1. Continue conducting surveys on a three to five year basis to monitor the fish population in Opal Lake. Include night electrofishing in the standard survey to monitor the largemouth bass population.

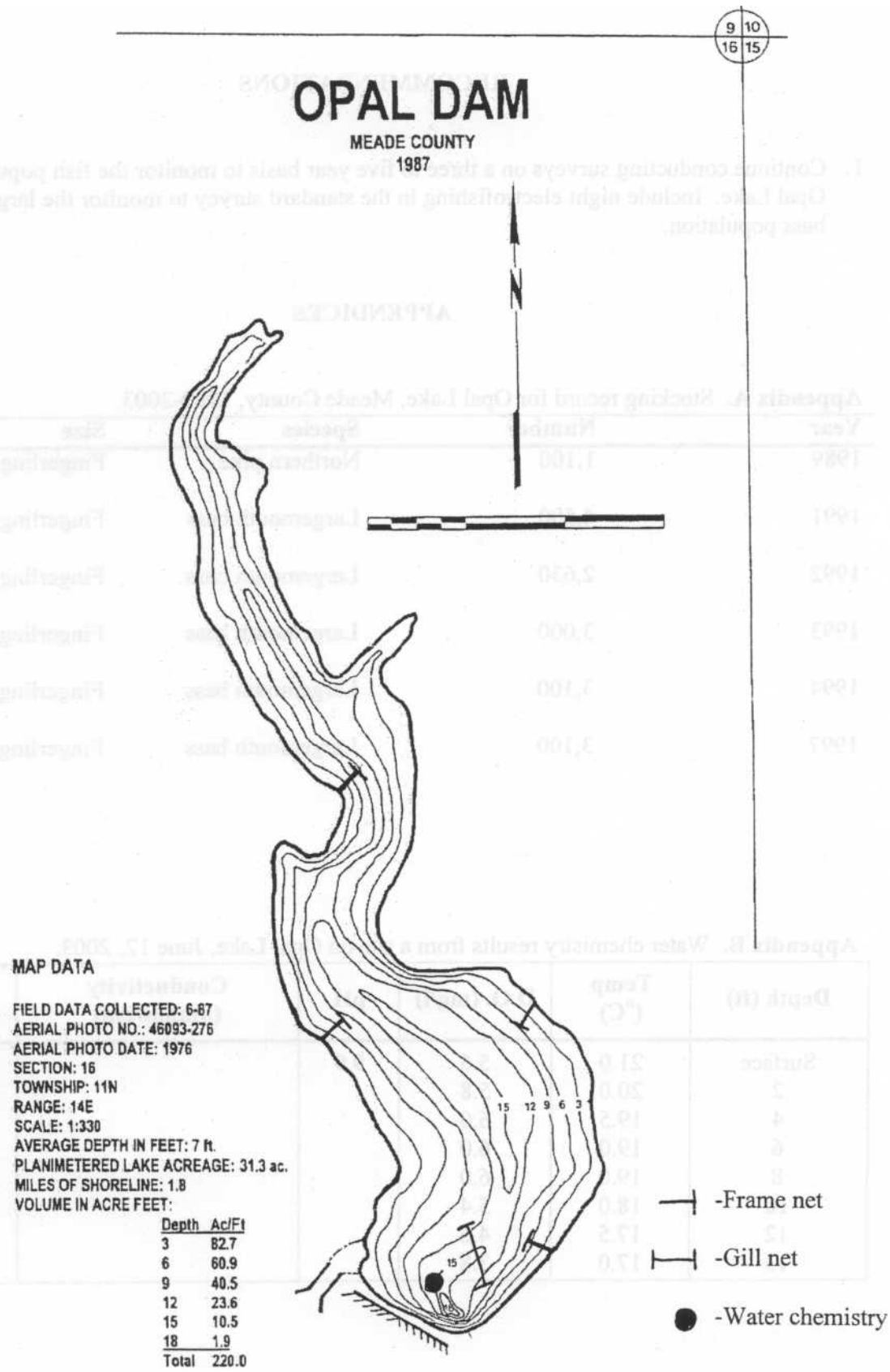
APPENDICES

Appendix A. Stocking record for Opal Lake, Meade County, 1989-2003.

Year	Number	Species	Size
1989	1,100	Northern pike	Fingerling
1991	4,500	Largemouth bass	Fingerling
1992	2,630	Largemouth bass	Fingerling
1993	3,000	Largemouth bass	Fingerling
1994	3,100	Largemouth bass	Fingerling
1997	3,100	Largemouth bass	Fingerling

Appendix B. Water chemistry results from a site on Opal Lake, June 12, 2003.

Depth (ft)	Temp (°C)	D.O. (mg/l)	pH	Conductivity (*u*mhos/cm)	Secchi disk (ft)
Surface	21.0	5.6	9.9		9
2	20.0	5.8			
4	19.5	6.0			
6	19.0	6.0			
8	19.0	6.0			
10	18.0	5.4			
12	17.5	4.6			
13	17.0	3.8			



Appendix C. Sample sites at Opal Dam..

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-36

Name: New Wall Lake County: Pennington
Legal description: T 1 S, R 15 E; Sec 1-2, 11-12
Location from nearest town: 1.5 mi. S and 1.5 mi. W of Wall, SD
Dates of present survey: October 7, 2003
Date last surveyed: June 24-26, 2002; September 11, 2002
Most recent lake management plan: F21-R-32 Date: 1998
Management classification: Warm water permanent
Contour mapped: Date 1985

Primary Species: (game and forage)	Secondary and other species:
1. Largemouth bass	1. White crappie
2. Bluegill	2. Black bullhead
3.	3. Yellow perch
4.	4. Northern Pike
5.	5. Walleye
6.	6. White sucker

PHYSICAL CHARACTERISTICS

Surface Area: 42 acres; Watershed: 3,780 acres
Maximum depth: 24 feet; Mean depth: 12.9 feet
Lake elevation at survey (from known benchmark): - 5 feet

1. Describe ownership of lake and adjacent lakeshore property:

New Wall Dam was built by and is maintained by the South Dakota Department of Game, Fish and Parks.

2. Describe watershed condition and percentages of land use:

The ownership of the watershed of New Wall Dam consists of: 10% state, 50% private, and 40% federal. Of the total 3,780 acres, 40% are agricultural (winter wheat) and 60% are short grass prairie.

3. Describe aquatic vegetative condition:

Low water has left some cattails out of the water, but on the steeper gradients some still enter the lake. Submergent vegetation is plentiful in the shallow, upper ends of the lake in water under five feet.

4. Describe pollution problems:

No pollution problems were identified by departmental personnel during the 2002 survey.

5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:

All structures associated with New Wall Dam are in good condition. The boat ramp is situated at the bottom of a steep hill and needs periodic maintenance.

BIOLOGICAL DATA

Methods

Night electrofishing was conducted at New Wall on October 7, 2003. Electrofishing was conducted using a Smith-Root unit with pulsed-DC. Conductivity was 800 uhmos with a water temperature of 21 degrees Celsius. Six, ten-minute sights were completed during the survey. All largemouth bass were collected, measured for total length (TL; mm) and weighed (g). In addition, scale samples were collected from up to 5 fish per centimeter group for age and growth analysis. All data was entered into WinFin 2.95 (Francis 1999).

Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch per unit effort (CPUE), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr) based on length categories. Abundance was expressed as the mean catch per unit effort (CPUE; mean number per hour of electrofishing). Actual pedal time (time the electrofishing unit produced current) was recorded from the digital display on the control box and used to calculate electrofishing CPUE. Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr.

Results and Discussion

New Wall Dam is an important public water body in Eastern Pennington County. Currently, largemouth bass and bluegill are managed as the primary game fish in New Wall Dam while white crappie and yellow perch are managed as secondary game fish. A 15-inch (381-mm) minimum length limit had been imposed on largemouth bass since 1994. In efforts to further improve bass size structure, a 12-inch to 16-inch slot with only one fish over 16 inches included in a daily limit of 5 was implemented January 1, 2003.

Fall electrofishing survey

Six, ten-minute stations of electrofishing captured 172 largemouth bass in 3600 seconds of pedal time. Largemouth bass were the only fish sought from this survey, which is done annually because of the regulation imposed on New Wall Dam. Some of the sites had dense algae on top of the water, resulting in very poor water clarity which surely reduced our CPUE by some degree.

Largemouth bass

A total of 172 largemouth bass were captured during fall, night electrofishing (Table 1). Mean CPUE was 172.0 for all largemouth bass. CPUE for largemouth bass stock length and longer was 160.0. Last year's CPUE were 184.8 and 91.4, respectively (Table 1). Size structure improved with a PSD of 49 and an RSD-P of 3. Last year, PSD was 37 and RSD-P was 1(Table 1). Last year only one fish overly inches was sampled, this year five were observed (Figure 2). Fish condition also increased slightly with a mean Wr for stock length and greater fish of 99.6 compared to 97.8 last year (Table 1). A trend of decreased condition as fish length increases, is observed in Figure 1. When compared to the 2002 data, this years trend has a smaller slope. Age and growth analysis indicates mean growth rates near the regional average but slightly slower than the state average (Table 2). The new regulation may increase growth as it encourages harvest on the smaller more abundant fish. This should decrease competition and improve growth.

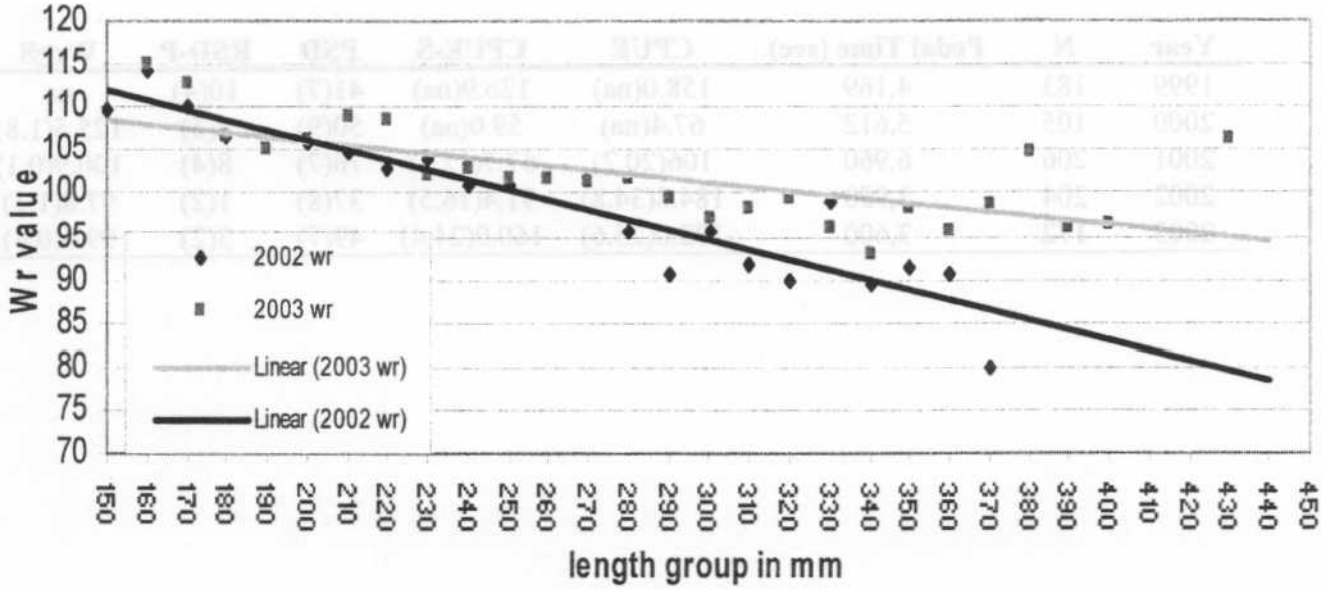
Table 1. Total catch (N), pedal time (seconds), catch per hour of electrofishing (CPUE), mean total length (TL, standard error is given in parentheses), proportional stock densities (PSD, RSD; 90% confidence intervals are given in parentheses) and condition factor (Wr for fish ≥ stock length; 80%CI's) for largemouth bass collected by electrofishing in New Wall Dam, Pennington County, 1999-2003

Year	N	Pedal Time (sec)	CPUE	CPUE-S	PSD	RSD-P	Wr≥S
1999	183	4,169	158.0(na)	126.9(na)	41(7)	10(4)	na
2000	105	5,612	67.4(na)	59.0(na)	50(9)	7(5)	125.5(1.8)
2001	206	6,960	106(20.2)	57.7(12.4)	76(7)	8(4)	100.9(0.1)
2002	204	3,950	184.8(34.8)	91.4(16.5)	37(8)	1(2)	97.8(1.1)
2003	172	3,600	172.0(25.6)	160.0(24.4)	49(7)	3(2)	99.6(0.4)

Table 2. New Wall Lake largemouth bass year class, age in 2003, sample size (N), mean back-calculated total length at age, population standard error (SE), Region 1 mean length at age, and the South Dakota largemouth bass mean length at age (Willis et al. 2001).

Year Class	Age	N	Age 1	2	3	4	5	6	7
2002	1	13	70						
2001	2	9	81	160					
2000	3	25	83	164	225				
1999	4	13	77	171	245	289			
1998	5	10	66	145	218	286	318		
1997	6	7	70	150	227	272	306	340	
1996	7	7	71	129	189	249	298	331	359
Mean		**84**	**74**	**153**	**221**	**274**	**307**	**336**	**359**
(SE)			**(2)**	**(6)**	**(9)**	**(9)**	**(6)**	**(5)**	**(0)**
Region 1 Mean			78	154	214	272	318		
S.D. Mean			96	182	250	305	342		

Figure 1. New Wall Dam largemouth bass condition factor (Wr) verses size (length group) in 2002 and 2003.



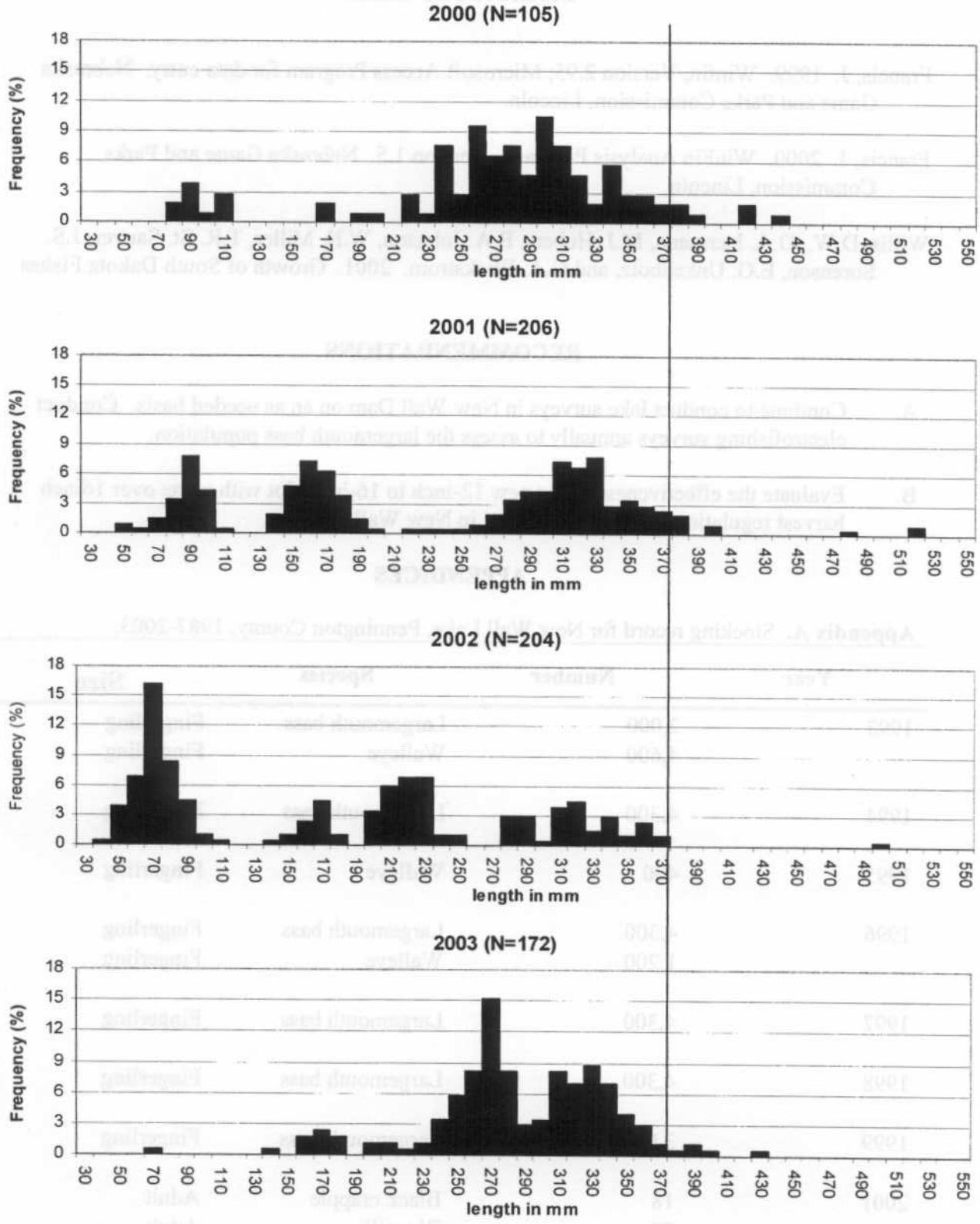


Figure 2. Length frequency histogram for Largemouth Bass at New Wall Dam for 2000-2003 with solid line representing 15 inches.

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RECOMMENDATIONS

A. Continue to conduct lake surveys in New Wall Dam on an as needed basis. Conduct electrofishing surveys annually to assess the largemouth bass population.

B. Evaluate the effectiveness of the new 12-inch to 16-inch slot with a one over 16inch harvest regulation on largemouth bass in New Wall Dam.

APPENDICES

Appendix A. Stocking record for New Wall Lake, Pennington County, 1987-2003.

Year	Number	Species	Size
1993	2,000	Largemouth bass	Fingerling
	4,600	Walleye	Fingerling
1994	4,300	Largemouth bass	Fingerling
1995	400	Walleye	Fingerling
1996	4,300	Largemouth bass	Fingerling
	1,200	Walleye	Fingerling
1997	4,300	Largemouth bass	Fingerling
1998	4,300	Largemouth bass	Fingerling
1999	3,000	Largemouth bass	Fingerling
2001	18	Black crappie	Adult
	50	Bluegill	Adult

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-36

Name: Wicksville Dam County: Pennington
Legal description: Sec. 32. T2N RI 3E
Location from nearest town: 1 mile East of Wicksville
Dates of present survey: June 9-11, 2003
Date last surveyed: July 29-30, 1991
Most recent lake management plan: F21-R-29 Date: 1995
Management classification: Warmwater Marginal
Contour mapped: No

Primary Species: (game and forage)	Secondary and other species:
1. Largemouth bass	1. Black Bullhead
2. Bluegill	2. Golden Shiner

PHYSICAL CHARACTERISTICS

Surface Area: 6 acres; Watershed: 1,664 acres
Maximum depth: 16 feet; Mean depth: 9 feet
Lake elevation at survey (from known benchmark): -1 feet

1. Describe ownership of lake and adjacent lakeshore property:

The land adjacent to most of the lake is owned by the County. The GF&P has a management agreement with Pennington County to provide planning, development and maintenance of Wicksville Dam. A small portion of the north end of the lake is privately owned.

2. Describe watershed condition and percentages of land use:

Wicksville's watershed is approximately 65% pasture land and 35% cropland.

3. Describe aquatic vegetative condition:

Summer months are often characterized as having large amounts of submergent vegetation to about six feet deep. Emergent vegetation surrounds the entire lake and consists of bulrush and cattail.

4. Describe pollution problems:

No pollution problems were identified during the 2003 survey.

5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:

No problems were noted in the 2003 survey. Wicksville dam does not have a boat ramp.

CHEMICAL DATA

1. Describe general water quality characteristics.

Field measurements included temperature and dissolved oxygen profile, surface pH, surface conductivity and transparency (Appendix B).

2. Thermocline: No

3. Secchi disc reading: 6.Oft.

4. Stations for water chemistry located on attached lake map: No

BIOLOGICAL DATA

Methods

A lake survey was conducted at Wicksville Dam on June 9-11, 2003. Sampling consisted of four trap nets set overnight before being run. All trap nets were modified fyke-nets with a 1.3-X 1.5-m frame, 19.1-mm (0.75-in) mesh and a 1.2- X 23-m (3.9- X 75.5-ft) lead. Collected fish were measured for total length (TL; mm) and weighed (g). In addition, scale samples for the first five fish per centimeter group were collected from selected fish per gear type for age and growth analysis. Scale samples were pressed onto acetate slides and viewed with a microfiche projector (40X) and the distance between scale annuli were recorded on paper strips. All data was entered into WinFin 2.95 (Francis 1999).

Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch-per-unit-effort (CPUE), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr) based on length categories. Abundance was expressed as the mean catch-per-unit-effort (CPUE; mean number per net night). Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr.

Results and Discussion

Wicksville Dam has not been surveyed since 1991. At this time only two species were sampled; bluegill and black bullhead. Largemouth bass were observed visually during the survey. Water levels had fallen to a point where we could not launch our shocking boat. The size structure and density on the bullheads would indicate that bass are keeping them in check. This simple system seems to be nearing the objectives of a "balanced population".

Table 1. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock-length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD-P; 90% CI's in parentheses) for all fish species collected from four, ¾ inch frame nets in Wicksville Dam, Pennington County June 10, 2003.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr>S
Black bullhead	18	4.5(2.0)	4.5(2.0)	100(--)	78(18)	102.6(3.8)
Bluegill	144	36.0(8.3)	36.0(8.3)	63(7)	1(1)	101.9(0.7)
total	162					

Black bullhead

Black bullhead densities were low with a frame net CPUE of 4.5(Table 1). Size structure was high with a PSD of 100 and a RSD-P of 78 (Table 1, Figure 1). Fish condition was good with a Wr for stock length and larger fish of 102.6. Though bass were not sampled due to low water, it would appear they are keeping bullhead densities low enough to have high size structure and excellent condition.

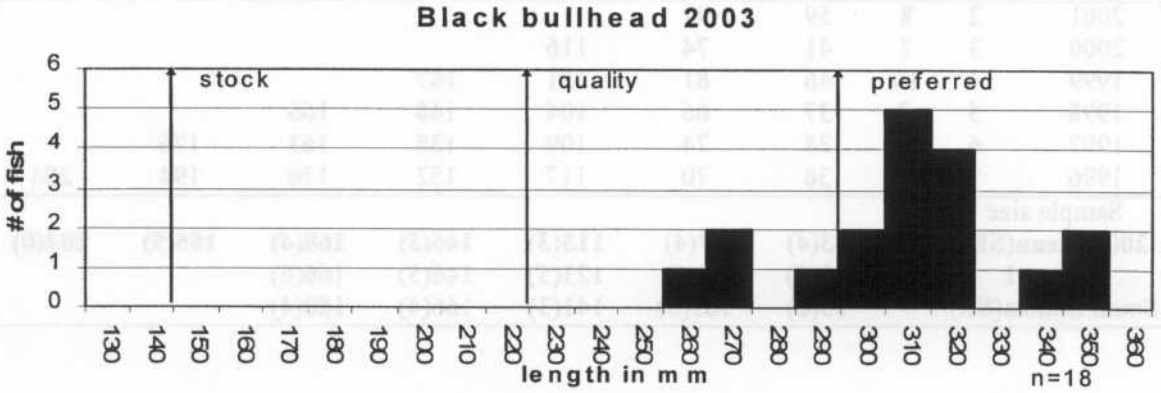

Figure 1. Length frequency histogram for black bullheads from frame nets at Wicksville Dam, June 10, 2003.

Bluegill

Bluegill dominated the frame net catch with a CPUE of 36.0 (Table 1). Stock Indices yielded a PSD of 63 and a RSD-P of 1 (Table 1). Fish condition was good with a Wr for stock length and larger fish of 101.9 (Table 1). Growth was slower than the statewide mean but right at the Region I mean (Table 2).

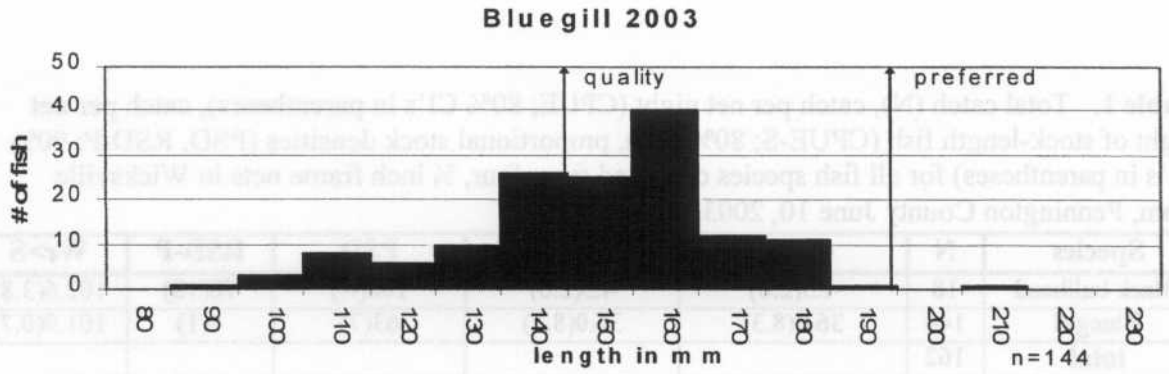

Figure 2. Length frequency histogram for black bluegill from frame nets at Wicksville Dam, June 10, 2003.

Table 2. Wicksville bluegill year class, age in 2003, sample size (N), mean back-calculated total length at age, population standard error (SE), and the South Dakota black crappie mean length at age and Region I mean length at age,(Willis et al. 2001).

Year Class	Age	N	Age 1	2	3	4	5	6	7
2001	2	8	59	97					
2000	3	7	41	74	116				
1999	4	18	46	81	121	147			
1998	5	7	37	66	104	148	166		
1997	6	1	38	74	109	138	163	176	
1996	7	1	36	70	117	152	176	194	204
Sample size		42							
2003 Mean(SE)			**43(4)**	**77(4)**	**113(3)**	**146(3)**	**168(4)**	**185(9)**	**204(0)**
Region 1			52(5)	92(6)	123(5)	146(5)	166(6)		
South Dakota(SE)			55(2)	103(3)	141(3)	166(4)	180(4)		

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Willis, D.W., D.A. Isermann, M.J. Hubers, B.A. Johnson, W.H. Miller, T.R. St. Sauver, J.S.Sorenson, E.G. Unkenholz, and G.A. Wickstrom. 2001. Growth of South Dakota Fishes

RECOMMENDATIONS

1. Survey largemouth bass population when water levels allow.

2. Resurvey panfish populations in five years.

APPENDICES

Appendix A. Stocking record for Wicksville Dam, Pennington County, 1990-2003.

Year	Number	Species	Size
1990	1200	LMB	FGL
1991	1000	LMB	FGL
1992	1000	LMB	FGL
1999	194	LMB	ADT

Appendix B. Water chemistry results from Wicksville Dam, Pennington County, June 9, 2003

Depth (ft)	Temp (°C)	D.O. (mg/l)	pH	Conductivity (*u*mhos/cm)	Secchi disk (ft)
Surface	20.0	6.8	8.6		6.0
2	19.0	6.6			
4	18.5	6.2			
6	18.0	5.4			
8	17.0	5.0			
10	16.5	4.6			
12	16.5	4.5			
14	15.5	4.5			
16	15.0	3.6			

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-36

Name: Coal Springs County(ies): Perkins
Legal description: Sec. 24, T. 17N, R. 16E
Location from nearest town: 3 mi. E, 6 mi. S, 3 mi. E, 1½ mi. S, and ½ mi. E of Meadow, SD
Dates of present survey: July 1-2, 2003
Date last surveyed: June 19-21, 1995
Most recent lake management plan: F21-R-31 Date: 1998
Management classification: Warmwater permanent
Contour mapped: Date NA

Primary Species:(game and forage)	Secondary and other species:
1. Largemouth bass	1. Northern pike
2. Walleye	2. Yellow perch
3.	3. Black bullheads

PHYSICAL CHARACTERISTICS

Surface Area: 90.3 acres; Watershed: 6,400 acres
Maximum depth: 23 feet; Mean depth: 12.1 feet
Lake elevation at survey (from known benchmark): -3 feet

1. Describe ownership of lake and adjacent lakeshore property:

A portion of Coal Springs dam lies within the southeast quarter of Section 24, which is owned by Perkins County. The remainder of the lake is located on private property. There is a 12-foot public easement along the lake.

2. Describe watershed condition and percentages of land use:

The Coal Springs Dam watershed is comprised of approximately 60% cropland, 39% rangeland, and the remaining 1 % as woodland.

3. Describe aquatic vegetative condition:

Cattails occupy much of the shoreline. Submergent vegetation was extremely heavy in areas where light penetrated to the bottom.

4. Describe pollution problems:

Department personnel identified no pollution problems during the 2003 survey.

5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:

Structures seemed in good condition. Coal Springs does not have a boat ramp.

CHEMICAL DATA

1. Describe general water quality characteristics.

Water chemistry parameters were collected on July 1, 2003 at I established station. Field measurements included temperature and dissolved oxygen profile, surface pH, surface conductivity and transparency (Appendix A).

2. Thermocline: No

3. Secchi disc reading: 9 feet

4. Stations for water chemistry located on attached lake map: No

BIOLOGICAL DATA

Methods

A lake survey was conducted on Coal Springs on July 1-2, 2003. Sampling consisted of two gill net nights and 8 trap net nights. The gill nets were a monofilament experimental net 45.7m (150-ft) long and 1.8m (6-ft) deep with six 7.6m (25-ft) panels of bar mesh sizes: 12.7mm (0.5in), 19.1 mm (0.75in), 25.4mm (1.0in), 31.8mm (1.25in), 38.1mm (1.5in), and 50.8mm (2.Oin). Trap nets were set at eight stations consisting of 4 trap net efforts each day. All trap nets were modified fyke-nets with a 1.3-X 1.5-m frame, 19.1 mm (0.75-in) mesh and a 1.2- X 23-m (3.9- X 75.5-ft) lead. Collected fish were measured for total length (TL; mm) and weighed (g). In addition, scale samples for the first five fish per centimeter group were collected from selected fish per gear type for age and growth analysis. Scale samples were pressed onto acetate slides and viewed with a microfiche projector (40X) and the distance between scale annuli were recorded on paper strips. All data was entered into WinFin 2.95 (Francis 1999).

Night electrofishing was conducted at Coal Springs on September 30, 2003. Electrofishing was conducted using a Smith-Root unit with pulsed-DC. A total of six, 10 minute stations were sampled. All largemouth bass and walleye were collected, measured for total length (TL; mm) and weighed (g). In addition, scale samples were collected from up to 5 fish per centimeter group for age and growth analysis. All data was entered into WinFin 2.95.

Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch-per-unit-effort (CPUE),

proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr) based on length categories. Abundance was expressed as the mean catch-per-unit-effort (CPUE; mean number per net night or mean number per hour of electrofishing). Actual pedal time (time the electrofishing unit produced current) was recorded from the digital display on the control box and used to calculate electrofishing CPUE. Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr.

Results and Discussion

Coal Springs is best described as a fishery dominated by black bullheads. In frame nets bullheads comprised 99.6% of the total catch by number, while in gill nets they comprised 96.2%. The lake appears to have a self sustaining walleye fishery as many different year classes are present in small numbers. Coal Springs hasn't been stocked with walleye since 1967. Low water has all but eliminated the yellow perch population, with only one fish being sampled during the entire survey. Individual fish indices are discussed below.

Table 1. Total catch (N), catch per net night (CPUE), catch per net night of stock length fish (CPUE-S), proportional stock densities (PSD, RSD; 90% CI's in parentheses) and condition factor (mean Wr for stock length and larger fish) for all fish species from four frame nets in Coal Springs, Perkins County, July 1-2, 2003.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr>S
Black bullhead	262	65.5(21.1)	65.5(21.1)	94(3)	0	--
Yellow perch	1	0.3(0.4)	0.3(0.4)	--	--	--
Totals	263					

Table 2. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock length fish (CPUE-S; 80% CI's in parentheses), proportional stock densities (PSD, RSD; 90% CI's in parentheses) and condition factor (mean Wr for stock length and larger fish) for all fish species from two experimental gillnets in Coal Springs, Perkins County, July 1-2, 2003.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr>S
Black bullhead	252	126.0(15.4)	126.0(15.4)	94(3)	0	103.3(2.4)
Northern pike	2	1.0(0.0)	1.0(0.0)	--	--	74.8(44.8)
Walleye	8	4.0(0.0)	4.0(0.0)	75(31)	50(36)	93.3(5.2)
Totals	262					

Table 3. Total catch (N), catch per hour of electrofishing (CPUE) with 80% CI in parentheses, catch per hour of stock length fish (CPUE-S) with 80% CI in parentheses, proportional stock densities (PSD, RSD) with 90% confidence intervals given in parentheses and condition factor (mean Wr for stock length and larger fish) for largemouth bass and walleye collected by night electrofishing in Coal Springs Dam, Perkins County, 2003.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr>S
LMB	16	16.0(5.4)	0.0	0	0	--
WAE	13	13.0(7.7)	12.0(6.5)	83(20)	25(23)	85.3(1.8)
Total	29					

Black Bullhead

Black bullheads dominated the frame net and gill net catch with a CPUE of 65.5 and 126.0, respectively (Tables 1 and 2). Stock indices were high with each gear type yielding a PSD of 94 and a RSD-P of 0 (Tables 1 and 2). Fish condition was excellent with a Wr of 103.3 (Table 2). With high size structure and excellent condition, it would appear walleye are keeping this population from stunting.

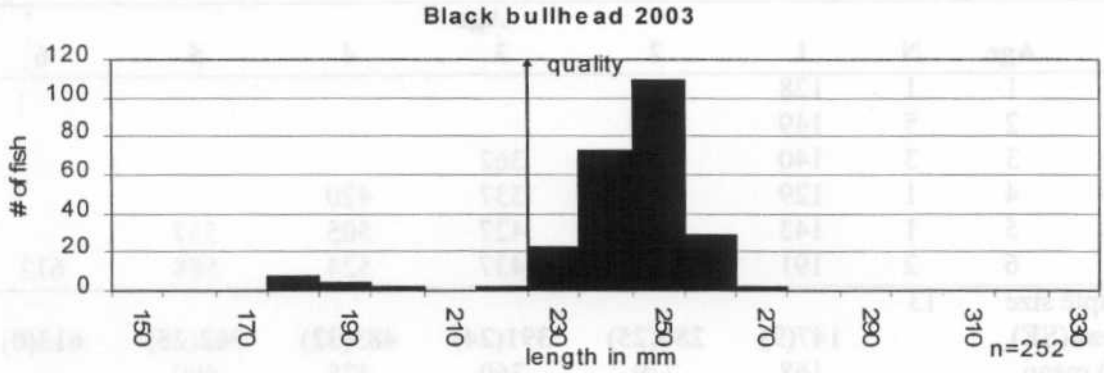

Figure 1. Length frequency histogram for black bullheads from gill nets at Coal Springs Dam, July 1-2, 2003.

Largemouth bass

Coal Springs has a very low density bass population with a CPUE of 16.0 fish per hour. None of the fish sampled were over stock length. In 2001, bass CPUE-S was 1.5. One of the 16 fish sample was one year old, the rest were young of the year. It would appear there is a small population of adult fish, as these young of year bass were naturally reproduced. Electrofishing conditions were tough due to limited visibility because of huge mats of vegetation.

Walleye

Walleye appear to be the dominate predator in Coal Springs. This is surprising since this population is entirely reproduced as they haven't been stocked since 1967. Gill net CPUE was 4.0 and electrofishing CPUE was 13.0 fish per hour. Length frequency histogram shows many different sizes of walleye (Figure 2). Age and growth data shows consistent recruitment and excellent growth (Table 4).

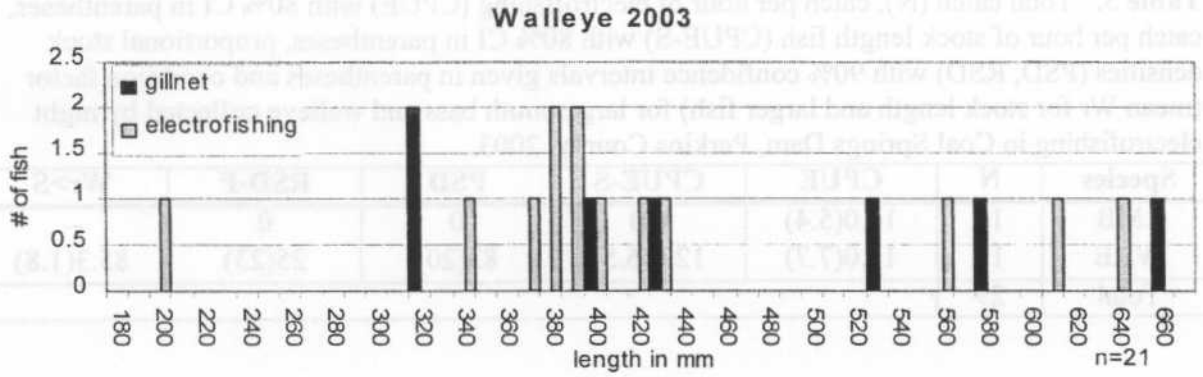

Figure 2. Length frequency histogram of walleye from gillnets and electrofishing at Coal Springs in 2003.

Table 4. Walleye at Coal Springs year class, age in 2003, sample size (N), mean back-calculated total length at age, population standard error (SE), and the South Dakota walleye mean length at age (Willis et al. 2001).

Year Class	Age	N	Age 1	2	3	4	5	6
2002	1	1	128					
2001	2	5	149	295				
2000	3	3	140	297	362			
1999	4	1	129	183	337	420		
1998	5	1	143	302	427	505	537	
1997	6	2	191	321	437	524	588	613
Sample size		13						
mean(SE)			**147(9)**	**280(25)**	**391(24)**	**483(32)**	**562(25)**	**613(0)**
SD mean			168	279	360	425	490	

Yellow Perch

The perch population is very low with no fish sampled in the gill net and one in the frame nets. Low water may have left no suitable spawning habitat available. A Christmas tree project is planned to help create spawning habitat even in low water.

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Francis, J. 2000. WinFin Analysis Program. Version 1.5. Nebraska Game and Parks Commission, Lincoln.

Willis, D.W., D.A. Isermann, M.J. Hubers, B.A. Johnson, W.H. Miller, T.R. St. Sauver, J.S. Sorenson, E.G. Unkenholz, and G.A. Wickstrom. 2001. Growth of South Dakota Fishes:

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-36

Name: East Lemmon Lake (Lemmon State Lake) County: Perkins
Legal description: T 21 N, R 17 E Sec. 16, 21
Location from nearest town: 11 mi. S. 7 mi. E Lemmon, SD
Dates of present survey: July 9-11, 2003; September 23, 2003
Date last surveyed: August 6-8, 2001; October 16, 2001
Most recent lake management plan: F21-R-29 Date: 1996
Management classification: Warmwater semi-permanent
Contour mapped: Date 1994

Primary Species: (game and forage)	Secondary and other species:
1. Largemouth bass	1. Green sunfish
2. Yellow perch	2. White sucker
3.	3. Black bullhead
4.	4. Channel catfish
5.	5. Golden shiner

PHYSICAL CHARACTERISTICS

Surface Area: 165 acres; Watershed: 49,500 acres
Maximum depth: 16 feet; Mean depth: 8.5 feet
Lake elevation at survey (from known benchmark): -3 feet

1. Describe ownership of lake and adjacent lakeshore property:
East Lemmon Lake is owned and managed by the South Dakota Department of Game, Fish and Parks. The dam structure and a small portion of the lake are located on private land.

2. Describe watershed condition and percentages of land use:
Ninety percent of the East Lemmon Lake watershed is privately owned agricultural land, the remainder is part of the Grand River National Grassland. The privately owned land is predominantly pasture and row crops, while the National Grassland is exclusively grazing land.

3. Describe aquatic vegetative condition:
Cattails and bulrush comprise much of the shoreline and littoral areas. During mid to late summer large mats of submergent vegetation are also present.

4. Describe pollution problems:
No pollution problems were identified by department personnel during the 2003 survey.

5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:
The spillway at East Lemmon Lake developed a cavity during the spring of 1995. A temporary repair of the badly damaged structure occurred in the fall of 1997. In the fall of 2000 a full repair of the dam including intakes, tubes and spillway was completed. The cost of the project at completion was $147,198. A boat ramp to provide public access was planned for the 2002 fiscal year, but has yet to be completed.

CHEMICAL DATA

1. Describe general water quality characteristics.
Water chemistry parameters were collected on July 10, 2003 at 1 established station (Figure 1). Field measurements included temperature and dissolved oxygen profile, surface pH, surface conductivity and transparency (Appendix A).

2. Thermocline: No

3. Secchi disc reading: 8 feet

4. Stations for water chemistry located on attached lake map: Yes

BIOLOGICAL DATA

Methods
A lake survey was conducted on East Lemmon Lake July 10-11, 2003. Sampling consisted of two gill net nights and 8 trap net nights (Appendix C). The gill nets were a monofilament experimental net 45.7-m (150-ft) long and 1.8-m (6-ft) deep with six 7.6-m (25-ft) panels of bar mesh sizes: 12.7-mm (0.5-in), 19.1-mm (0.75-in), 25.4-mm (1.0-in), 31.8-mm (1.25-in), 38.1-mm (1.5-in), and 50.8-mm (2.0-in). Trap nets were set at eight stations consisting of 4 trap net efforts each day. All trap nets were modified fyke-nets with a 1.3-X 1.5-m frame, 19.1-mm (0.75-inch) mesh and a 1.2- X 23-m (3.9- X 75.5-ft) lead. Collected fish were measured for total length (TL; mm) and weighed (g). In addition, scale samples for the first five fish per centimeter group were collected from selected fish per gear type for age and growth analysis. Scale samples were pressed onto acetate slides and viewed with a microfiche projector (40X) and the distance between scale annuli were recorded on paper strips. All data was entered into WinFin 2.95 (Francis 1999).

Night electrofishing was conducted at East Lemmon Lake on September 23, 2003. Electrofishing was conducted using a Smith-Root unit with pulsed-DC. A total of four 10 minute stations were sampled. All largemouth bass were collected, measured for total length (TL; mm) and weighed (g). In addition, scale samples were collected from up to 5 fish per centimeter group for age and growth analysis. All data was entered into WinFin 2.95.

Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch per unit effort (CPUE),

proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr) based on length categories. Abundance was expressed as the mean catch per unit effort (CPUE; mean number per net night or mean number per hour of electrofishing). Actual pedal time (time the electrofishing unit produced current) was recorded from the digital display on the control box and used to calculate electrofishing CPUE. Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr.

Results and Discussion

East Lemmon Lake has been suffering from either summer or winter fish kills. These kills have decimated entire year classes of perch and bass. Sampling has shown that some fish have survived these kills and remain in high enough numbers to repopulate the lake on their own. Hopefully, lake levels will come up this spring and reduce the chances of more fish kills. Dominate fish species are discussed individually below.

Fish Community Survey

Gill and Trap Net Catch

A total of five species were collected in both gill nets and trap nets during the 2003 survey of East Lemmon Lake. Four of the species, totaling 111 fish, were collected in experimental gill nets (Table 2). White sucker (N=81) was the most common species collected and black bullhead (N=26) the second most common. Other species collected in gill nets were largemouth bass (N=1) and yellow perch (N=3).

Three species were collected in trap nets, totaling 379 fish. Similar to gill nets white sucker (N=300) were the most common and black bullhead (N=77) the second most common (Table 1). Two yellow perch were also sampled in the frame nets.

Night electrofishing Catch

East Lemmon Lake was night electrofished for a total of 2400 seconds of pedal time. Only largemouth bass (N=79) were targeted (Table 3). Most largemouth bass collected were age-0 fish and less than 150 mm. Partial fish kills were reported and are likely the cause for few adult fish collected during sampling.

Table 1. Total catch (N), catch per net night (CPUE), catch per net night of stock length fish (CPUE-S), proportional stock densities (PSD, RSD; 90% CI's in parentheses) and condition factor (mean Wr for stock length and larger fish) for all fish species from eight frame nets in East Lemmon Lake, Perkins County, July 10-11, 2003.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr>S
Black bullhead	77	9.6(3.0)	9.6(3.0)	97(3)	71(9)	102.7(2.9)
White sucker	300	37.5(14.2)	37.5(14.2)	100(-)	99(1)	--
Yellow perch	2	0.3(0.2)	0.1(0.2)	--	--	104.2(--)
Totals	379					

Table 2. Total catch (N), catch per net night (CPUE), catch per net night of stock length fish (CPUE-S), proportional stock densities (PSD, RSD; 90% CI's in parentheses) and condition factor (mean Wr for stock length and larger fish) for all fish species from two experimental gill nets in East Lemmon Lake, Perkins County, July 10-11, 2003.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr>S
Black bullhead	26	13.0(12.3)	13.0(12.3)	92(9)	77(14)	105.5(2.8)
Largemouth bass	1	0.5(1.5)	0.5(1.5)	--	--	95.9(-)
White sucker	81	40.5(7.7)	40.5(7.7)	100(-)	98(3)	100.8(0.7)
Yellow perch	3	1.5(1.5)	1.0(0.0)	--	--	118.1(63.1)
Totals	111					

Table 3. Total catch (N), catch per hour of electrofishing (CPUE; 80% CI's in parentheses), catch per hour of stock length fish (CPUE-S; 80% CI's), proportional stock densities (PSD, RSD-P; 90% CI's) and condition factor (mean Wr for stock length and larger fish) for largemouth bass collected by electrofishing in East Lemmon Lake, Perkins County, September 23, 2003.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr>S
Largemouth bass	79	118.5(88.6)	6.0(5.7)	100(-)	100(-)	120.5(5.8)

Black bullheads

Black bullheads were the second most abundant fish captured in both trap nets and gill nets. Mean CPUE in frame nets was 9.6 while gillnet CPUE was 13.0 (Tables 1 and 2). In 2001, CPUE was 6.0 and 27.0, respectively. Bullheads ranged in size from 170 mm to 340 mm (Figure 2). Stock density indices were high with a PSD of 97 and a RSD-P of 71 from the frame net sample (Table 1). Mean condition for stock length and larger fish was 102.7 (Table 1). These numbers would indicate a low to moderate population with high size structure and poor recruitment in recent years. Possibly the largemouth bass population and low water levels are keeping recruitment in check.

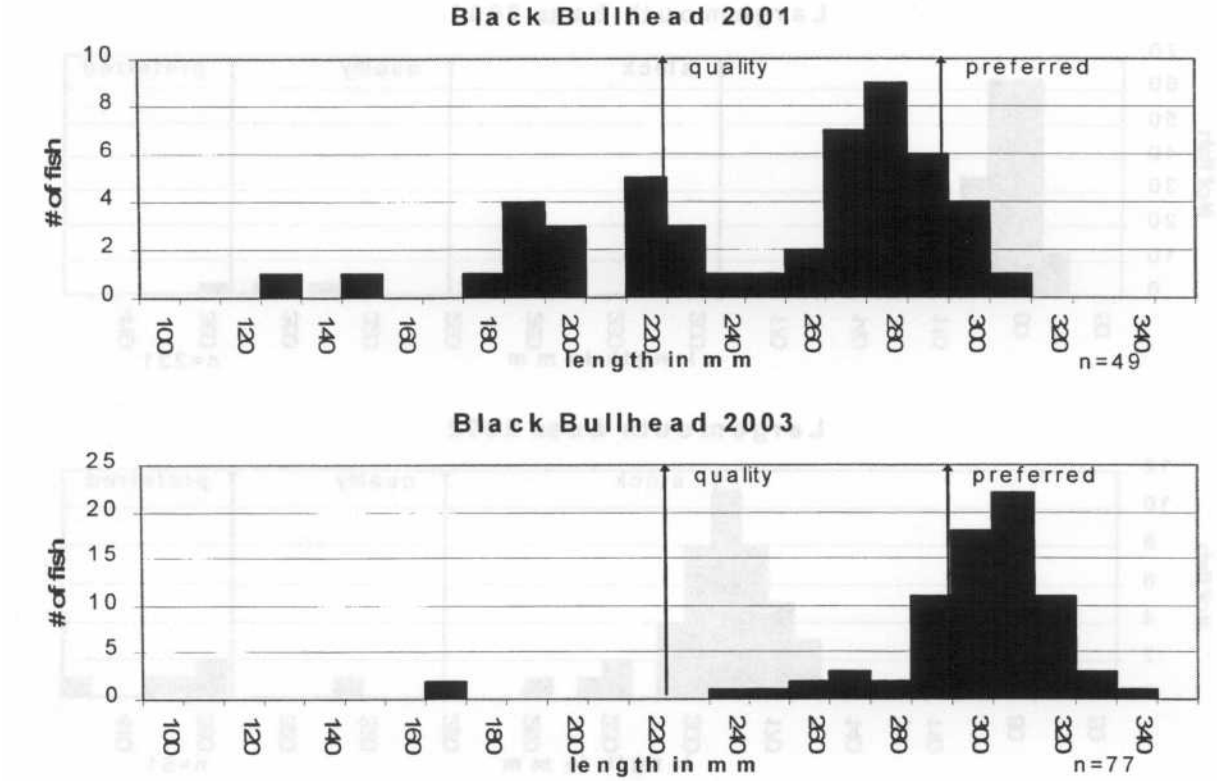

Figure 1. Length histogram of black bullheads collected in frame nets from East Lemmon Lake, Perkins County, 2001, 2003.

Largemouth bass

A total of 79 largemouth bass were captured during night electrofishing (Table 5). Mean CPUE was 118.5 for all largemouth bass and mean CPUE for largemouth bass stock length or greater was 6.0. Size of fish collected ranged from 80 mm to 420 mm (Figure 3). Stock density indices were high (PSD=100, RSD-P=100) but few fish stock length and greater were collected. No age and growth data was completed due to the small sample size.

Although largemouth bass density was high, only 4 bass greater than stock length were collected. The absence of stock length bass was most likely due to fish kills during summer or winter. The entire 2001 and 2002 year classes disappeared in the 2003 sample (Figure 2). Night electrofishing also produced a large number of age-0 fish. Condition of the larger bass was excellent with a Wr for stock length and larger fish of 120.5.

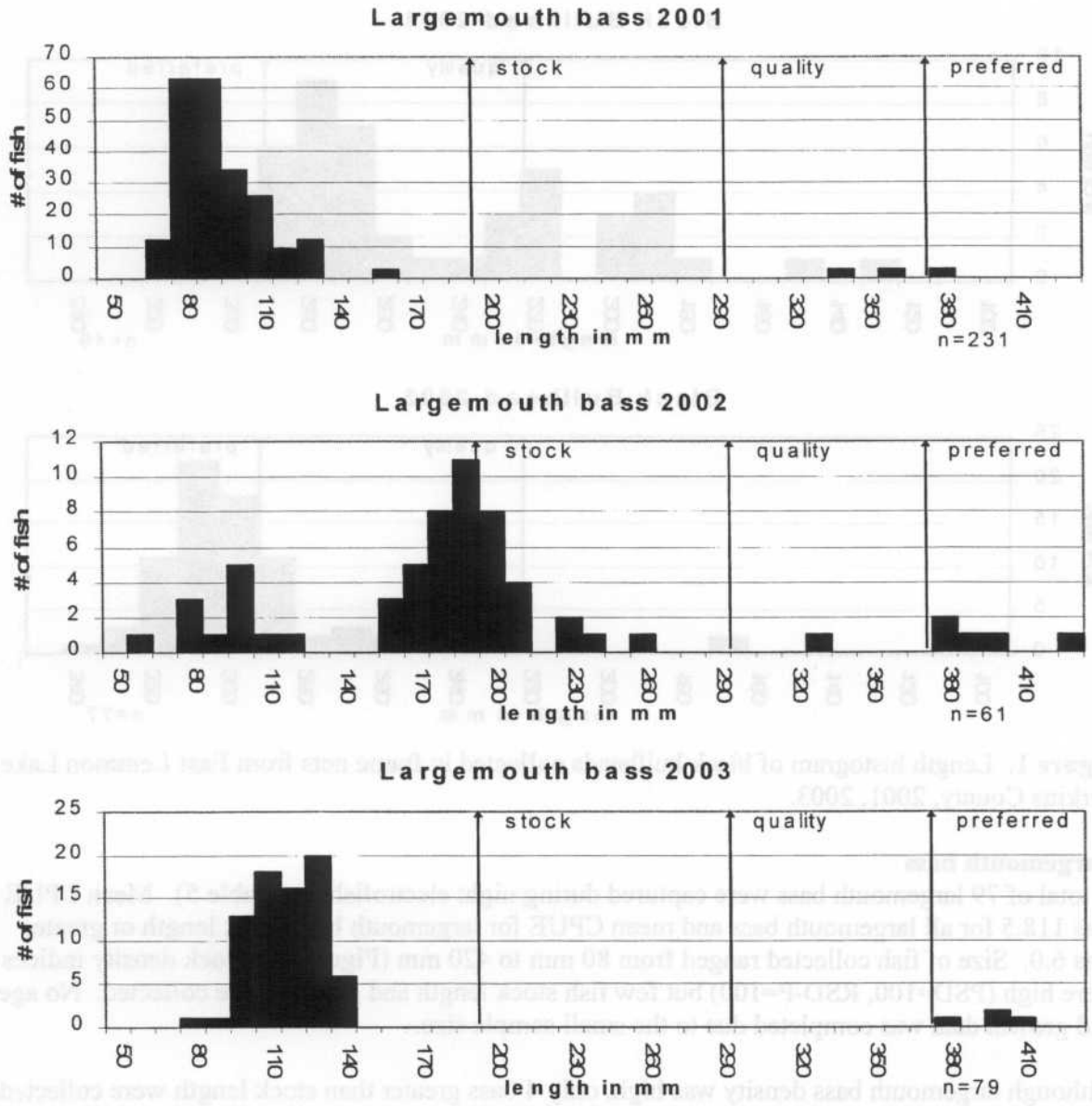

Figure 2. Length histogram of largemouth bass collected by electrofishing from East Lemmon Lake, Perkins County, 2001-2003.

White suckers

White suckers were the second most numerous fish collected in both gill nets and trap nets. CPUE for gill nets was 40.5 and for trap nets 37.5 (Tables 1 and 2). In 2001 CPUE was 93 and 25.9, respectively. Size structure was high with RSD-P values of 98 or greater (Tables 1 and 2). Lengths of white suckers ranged from 280mm to 460mm (Figure 3). Mean Wr for stock length and larger fish was 100.8 (Table 2). No age and growth analyses were done.

The white sucker population is extremely abundant. This is an ongoing problem with East Lemmon Lake that will most likely not be solved. The lake was rotenoned in 1981 to remove an overabundant sucker population. The watershed was not treated, however, and it was reported that the potential for re-overpopulation by suckers was high. Although density was high, both size structure and condition of white suckers were good. It appears this population is doing well but hopefully a recovering largemouth bass population can reduce the density.

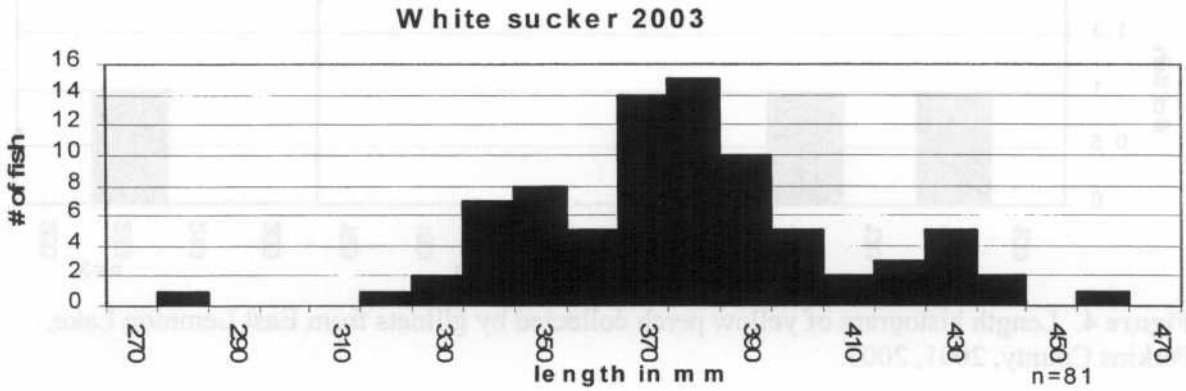

Figure 3. Length histogram of white sucker collected by gillnets from East Lemmon Lake, Perkins County, July 10-11, 2003.

Yellow perch

Abundance of yellow perch was high in 2001, with a mean CPUE in trap nets of 38.3 and 205.0 in gill nets. The perch population has crashed as CPUE was 0.3 and 1.5, respectively (Tables 1 and 2). Obviously, some sort of winter or summer kill has taken out most of the perch population. In 2001, the oldest fish aged was 4 years old indicating a young population. If East Lemmon Lake fills up, perch should be able to replenish themselves rather quickly.

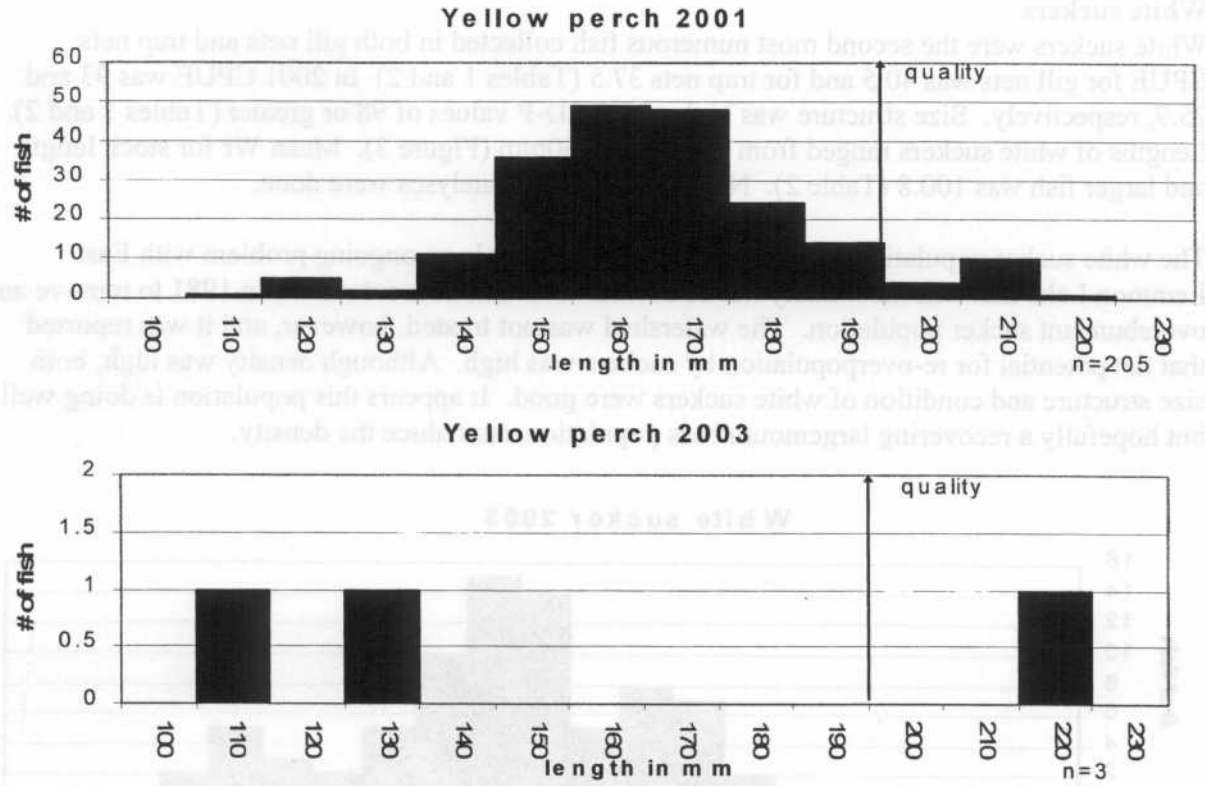

Figure 4. Length histogram of yellow perch collected by gillnets from East Lemmon Lake, Perkins County, 2001, 2003.

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RECOMMENDATIONS

1. Continue conducting lake surveys once every 5 years to evaluate fish populations and stocking success.

2. Continue annual fall night electrofishing to develop long-term trend data of largemouth bass due to frequent winterkill.

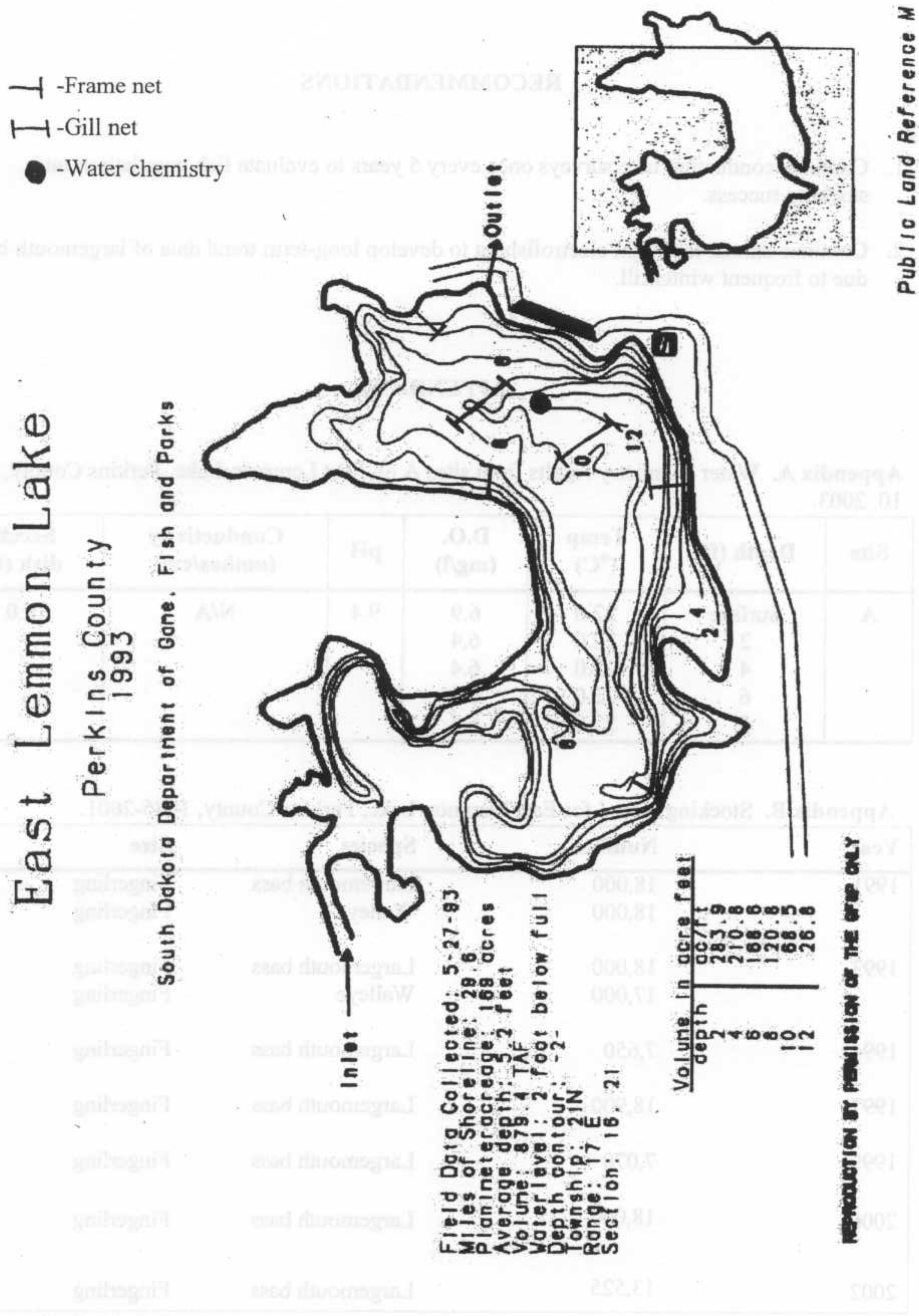
APPENDICES

Appendix A. Water chemistry results from sites A on East Lemmon Lake, Perkins County, July 10, 2003.

Site	Depth (ft)	Temp (°C)	D.O. (mg/l)	pH	Conductivity (*u*mhos/cm)	Secchi disk (ft)
A	Surface	22.0	6.9	9.4	N/A	8.0
	2	22.0	6.4			
	4	22.0	6.4			
	6	22.0	6.4			
	8	22.0	6.3			

Appendix B. Stocking record for East Lemmon Lake, Perkins County, 1985-2001.

Year	Number	Species	Size
1991	18,000	Largemouth bass	Fingerling
	18,000	Walleye	Fingerling
1993	18,000	Largemouth bass	Fingerling
	17,000	Walleye	Fingerling
1994	7,650	Largemouth bass	Fingerling
1997	18,900	Largemouth bass	Fingerling
1999	7,070	Largemouth bass	Fingerling
2000	18,000	Largemouth bass	Fingerling
2002	13,525	Largemouth bass	Fingerling



Appendix C. Sampling sites on East Lemmon Lake.

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-36

Name: Flat Creek Lake County: Perkins
Legal description: T21 N, R16 E, Sec. 20 & 21
Location from nearest town: 0.5,mi. west, 10 mi. south of Lemmon, SD
Dates of present survey: July 9-11, 2003
Date last surveyed: June 20, 2000
Most recent lake management plan: F21-R-29 Date: 1996
Management classification: Warmwater semi-permanent
Contour mapped: Date N/A

Primary Species: (game and forage)	Secondary and other species:
1. Black bullhead	1. Channel catfish
2. Black crappie	2. Common carp
3. Bluegill	3. Golden shiner
4. Northern pike	4.
5. Yellow perch	5.

PHYSICAL CHARACTERISTICS

Surface Area: 203.4 acres; Watershed: 102,400 acres
Maximum depth: 24 feet; Mean depth: 7.9 feet
Lake elevation at survey (from known benchmark): -1 feet

1. Describe ownership of lake and adjacent lakeshore property:
Flat Creek Lake was constructed as a WPA dam in the 1930's. Flat Creek Lake is divided by Highway 73 and has excellent access from the highway. Access on the east half is limited due to private ownership.

2. Describe watershed condition and percentages of land use:
The Flat Creek Lake watershed consists of approximately 102,400 acres. Approximately 50% of this acreage is cropland, 49% rangeland and 1 % woodland.

3. Describe aquatic vegetative condition:
Cattails and bullrush surround most of the shoreline areas on both sides of the highway.

4. Describe pollution problems:
Department personnel identified no pollution problems during the 2003 survey.

5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:
All structures appeared to be in good condition during the 2003 lake survey. Currently, boats can be launched just off HWY 73 in the southwest corner.

CHEMICAL DATA

1. Describe general water quality characteristics:

Water chemistry parameters were collected on July 10, 2003 at an established station. Field measurements included temperature and dissolved oxygen profile, surface pH, surface conductivity and transparency (Appendix B).

2. Thermocline: No

3. Secchi disc reading: 3ft

4. Stations for water chemistry located on attached lake map: Yes

BIOLOGICAL DATA

Methods
The fish population in Flat Creek Lake was sampled with the use of two sinking experimental gill nets and four modified fyke trap nets (Appendix C). The gill nets measured 150 X 6-ft with each mesh panel 25 ft in length and mesh sizes 0.5 in, 0.75 in, 1.25 in, 1.5 in, and 2.0 in (bar measure). Trap nets consisted of a 4-X 5-ft frame, 4-X 75-ft lead and 0.75-in bar mesh. Collected fish were measured for total length (TL; mm) and weighed (g). Scale samples were collected from black crappie, bluegill, and yellow perch for age and growth analysis. All data was entered into Winfin 2.95 (Francis 1999).

Abundance of individual fish species was expressed as the mean catch per unit effort (CPUE); the mean number of fish for each species collected per net night. Total effort was over two nights totaling two gill net nights and eight trap net nights. Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were CPUE, proportional stock density (PSD), relative stock density (RSD), and relative weight (Wr) based on length categories.

Results and Discussion
Nine species, totaling 1,791 fish, were collected during the present survey. Black bullheads were the most abundant fish collected in trap nets and gill nets with 51 % and 86%, respectively. Bluegill was the second most abundant species collected in trap nets and black crappie the third. Other species collected were channel catfish, common carp, hybrid sunfish, northern pike, white

sucker and yellow perch. Flat Creek Lake needs more predators to help control bullhead and panfish numbers which should increase panfish quality.

Table 1. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock-length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD-P; 90% CI's in parentheses), condition factor (Wr for fish ≥ stock length; 80%CI's) for all fish species collected from seven, ¾ inch frame nets in Flat Creek Lake, Perkins County July 9-11, 2003.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr ≥ S
BLB	790	112.9(30.3)	--	--	--	--
BLC	316	45.1(14.2)	45.1(14.2)	13(3)	0	99.2(0.9)
BLG	340	48.6(16.8)	48.6(16.8)	43(5)	0	97.8(1.5)
BLGxGSF	3	0.4(1.6)	--	--	--	--
CCF	21	3.0(1.5)	2.9(1.3)	10(12)	0	90.7(2.1)
COC	16	2.3(1.3)	2.3(1.3)	94(11)	0	80.2(0.6)
NOP	8	1.1(0.5)	1.1(0.5)	100	75(31)	86.6(3.2)
YEP	54	7.7(5.0)	7.7(5.0)	0	0	84.7(0.7)
Total	1548					

Table 2. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD-P; 90% CI's in parentheses), and condition factor (Wr for fish ≥ stock length; 80%CI's) for all fish species collected from two, 150-ft experimental sinking gill nets in Flat Creek Lake, Perkins County July 9-11, 2003.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr ≥ S
BLB	210	105.0(52.3)	105(52.3)	0	0	87.6(1.4)
CCF	5	2.5(1.5)	1.5(1.5)	0	0	103.6(5.5)
COC	12	6.0(6.2)	6.0(6.2)	92(15)	0	85.3(1.9)
NOP	4	2.0(3.1)	2.0(3.1)	--	--	92.6(8.6)
WHS	1	0.5(1.5)	0.5(1.5)	--	--	89.5(--)
YEP	11	5.5(13.9)	5.5(13.9)	0	0	87.6(1.6)
Total	243					

Black bullheads

Black bullheads are extremely abundant in Flat Creek Lake. Gill net CPUE was 105.0 and trap net CPUE was 112.9 (Tables 1 and 2). In 2000, mean CPUE in gill nets was 43 fish and mean CPUE in trap nets was 141. Size structure of the bullhead population was very poor and no large bullheads were collected during sampling. Stock density indices (PSD, RSD-P) were zero for both gill nets and trap nets indicating no quality length (230 mm) bullheads were collected. In 2000, PSD and RSD-P were also zero. The length frequency histograms show nearly identical size structure from 2000 to 2003 (Figure 1). Mean Wr for fish over stock length was 87.6. The black bullheads sampled in Flat Creek Lake appear to be characteristic of an overabundant population (i.e. large numbers, small sizes). Although no age and growth analyses were completed it was apparent from the lack of larger fish that the bullhead population was experiencing limited growth.

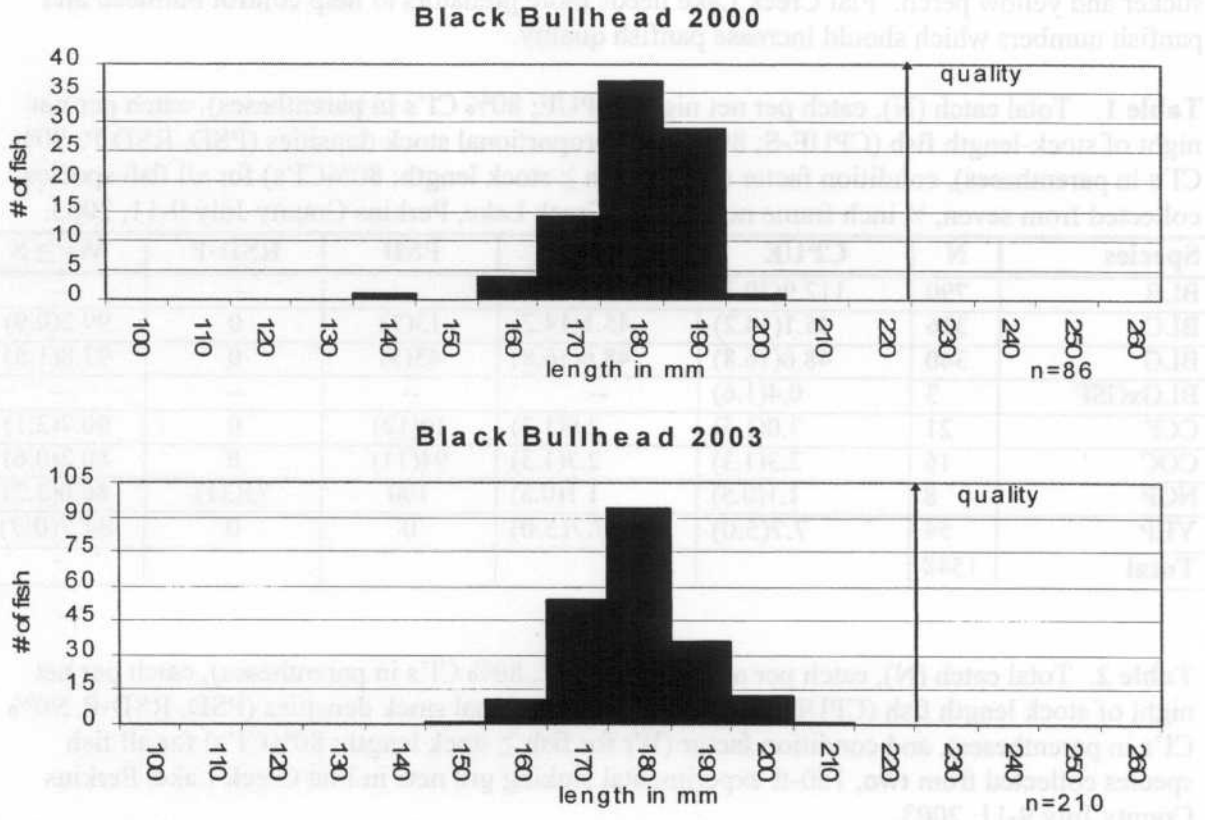


Figure 1. Length frequency histograms for black bullheads from gillnets in Flat Creek Lake 2000, 2003.

Black crappies

Black crappies density has increased since the 2000 survey. In 2000, mean trap net CPUE was 16.1, size structure was small with PSD=47 and RSD-P=1. This survey had a CPUE of 45.1 (Table 1). Stock indicies were low with a PSD of 13 and a RSD-P of 0. Fish condition for stock length and larger crappie was good with a Wr of 99.2. Crappie condition decreased as fish length increased (Figure 3). Growth was slow, well below the statewide mean (Table 3). The Flat Creek Lake crappie population shows characteristics of an overabundant fish community. The small size of black crappies and decreasing condition values as crappies increase in length may suggest inter- or intra-specific competition is occurring with the black bullhead population. Until black bullhead numbers are somehow reduced it would be expected that the crappie population will remain in a similar state.

Table 3. Flat Creek Reservoir black crappie year class, age in 2003, sample size (N), mean back-calculated length (mm) at age, population mean length at age in 2003 with standard errors in parentheses, and the South Dakota mean length at age (Willis et al. 2001).

Year Class	Age	N	Age 1	2	3	4	5
2001	2	17	85	136			
2000	3	12	78	130	167		
1999	4	8	82	136	171	193	
1998	5	5	83	146	179	200	212
total		32					
Mean(SE)			**82(2)**	**137(3)**	**172(4)**	**196(3)**	**212(0)**
S.D. Mean			83(2)	147(4)	195(5)	229(6)	249(6)

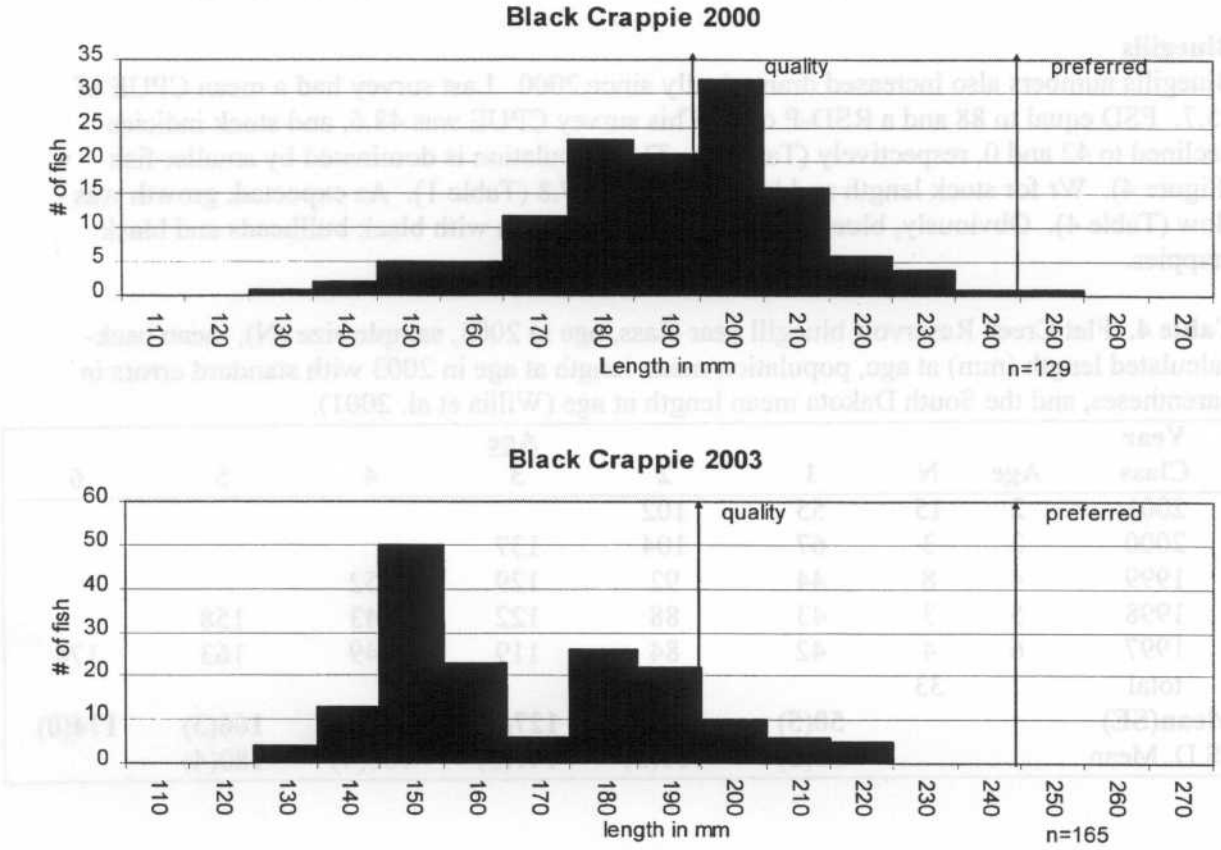


Figure 2. Length frequency histograms for black crappie from frame nets in Flat Creek Lake 2000-2003.

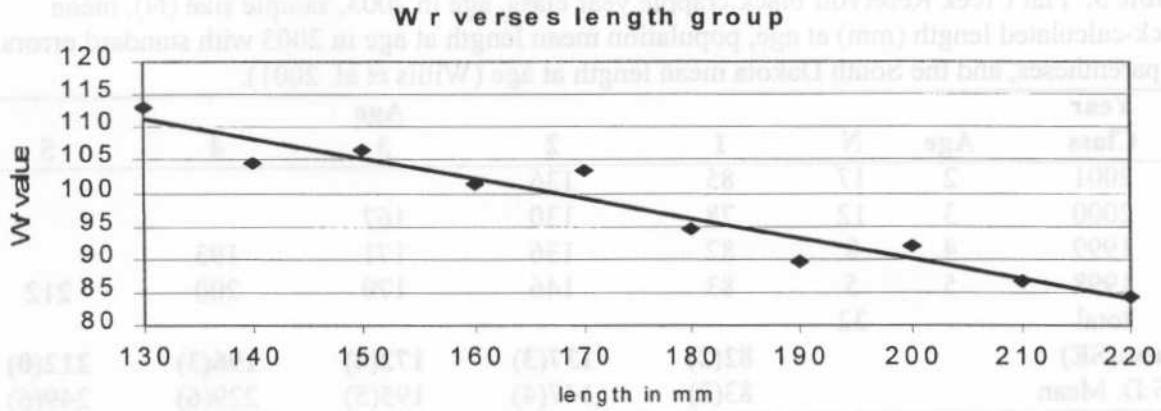


Figure 3. Flat Creek black crappie condition factor (Wr) verses size (length group).

Bluegills

Bluegills numbers also increased dramatically since 2000. Last survey had a mean CPUE of 25.7. PSD equal to 88 and a RSD-P of 0. This survey CPUE was 48.6, and stock indicies declined to 42 and 0, respectively (Table 1). This population is dominated by smaller fish (Figure 4). Wr for stock length and larger fish was 97.8 (Table 1). As expected, growth was slow (Table 4). Obviously, bluegill are also in competition with black bullheads and black crappies.

Table 4. Flat Creek Reservoir bluegill year class, age in 2003, sample size (N), mean back-calculated length (mm) at age, population mean length at age in 2003 with standard errors in parentheses, and the South Dakota mean length at age (Willis et al. 2001).

Year Class	Age	N	Age 1	2	3	4	5	6
2001	2	15	55	102				
2000	3	3	67	104	137			
1999	4	8	44	92	129	152		
1998	5	3	43	88	122	143	158	
1997	6	4	42	84	119	149	163	174
total		33						
Mean(SE)			**50(5)**	**94(4)**	**127(4)**	**148(3)**	**160(3)**	**174(0)**
S.D. Mean			55(2)	103(3)	141(3)	166(4)	180(4)	

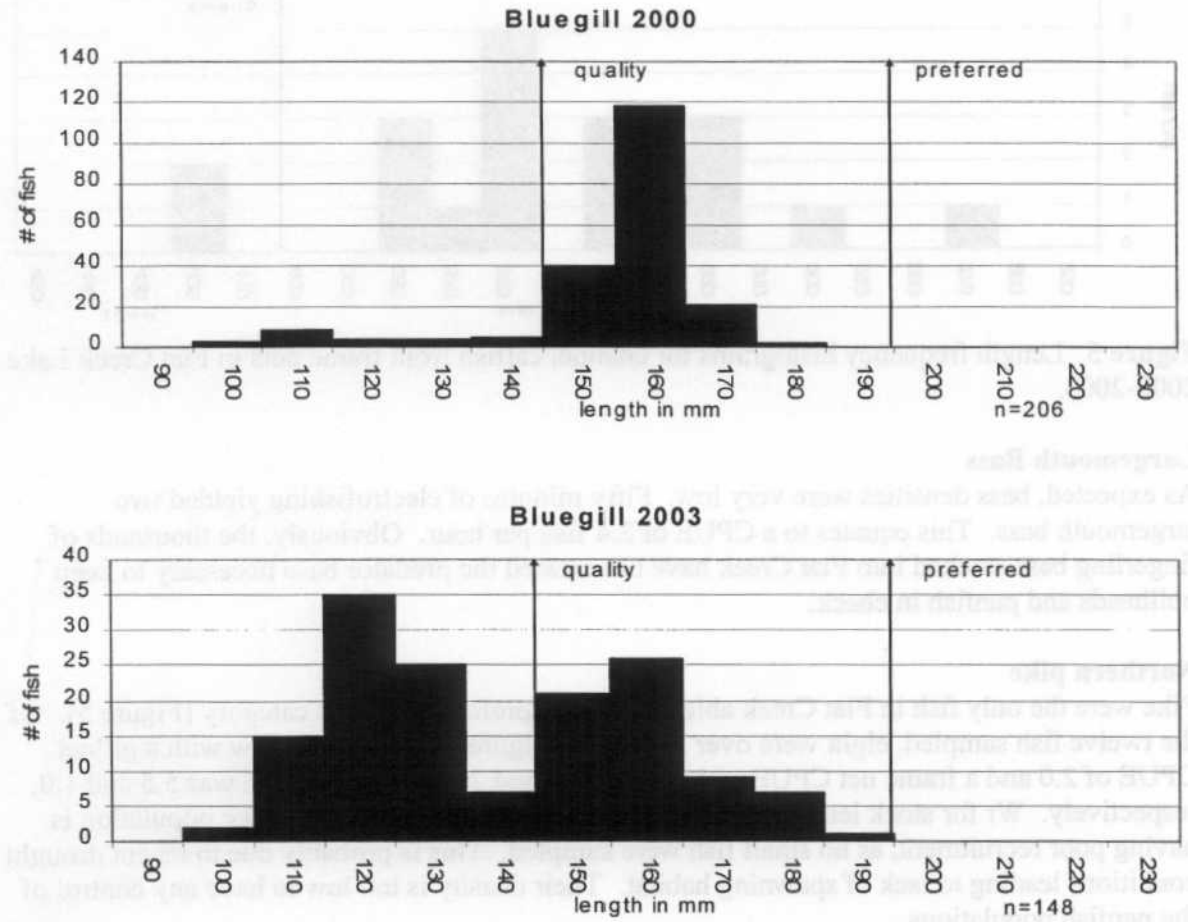


Figure 4. Length frequency histograms for bluegill from frame nets in Flat Creek Lake 2000-2003.

Channel catfish

Flat Creek's catfish population appears to be on the increase with a frame net CPUE of stock length and larger fish of 2.9. In 2000, frame net CPUE-S was 0.1. Length frequency histogram shows that most fish are under quality length (Figure 5). Wr for fish stock length and larger was 90.7.

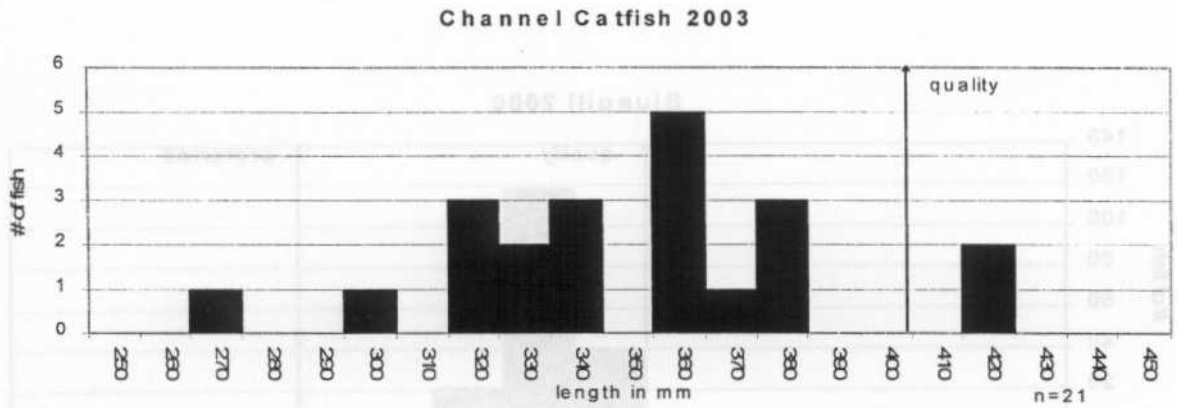


Figure 5. Length frequency histograms for channel catfish from frame nets in Flat Creek Lake 2000-2003.

Largemouth Bass

As expected, bass densities were very low. Fifty minutes of electrofishing yielded two largemouth bass. This equates to a CPUE of 2.4 fish per hour. Obviously, the thousands of fingerling bass stocked into Flat Creek have not created the predator base necessary to keep bullheads and panfish in check.

Northern pike

Pike were the only fish in Flat Creek able to reach a "preferred" length category (Figure 5). Of the twelve fish sampled, eight were over 28 inches (Figure 6). Density is low with a gillnet CPUE of 2.0 and a frame net CPUE of 1.1 (Tables 1 and 2). In 2000, CPUE was 5.5 and 1.0, respectively. Wr for stock length and larger fish was 86.6. It appears the pike population is having poor recruitment, as no small fish were sampled. This is probably due to recent drought conditions leading to lack of spawning habitat. Their density is too low to have any control of the panfish populations.

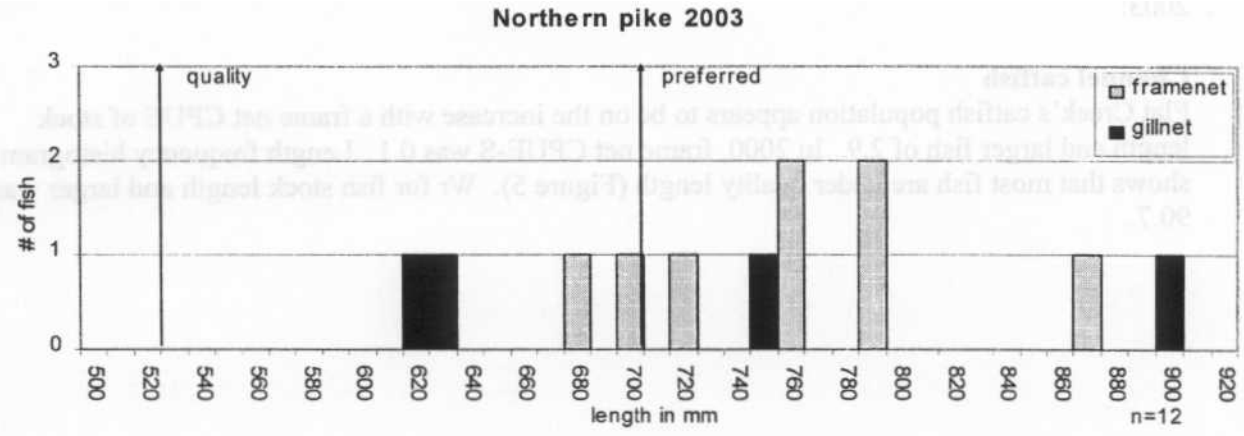


Figure 6. Length frequency histograms for northern pike from frame nets and gillnets in Flat Creek Lake 2003.

Yellow perch

The yellow perch population is suffering from competition with the bullheads and other panfish. In 2000, gill net CPUE-S was 5.0 and frame net CPUE-S was 1.6. This year CPUE-S was 5.5 and 7.7 (Tables 1 and 2). As in the previous survey, no fish were sampled over quality length (8-inches) (Figure 7). Condition of stock length perch was low, with a mean Wr value of 84.7 (Table 1). Age and growth were completed and results are shown in Table 5. By age four, Flat Creek perch were two inches behind the state average (Table 5).

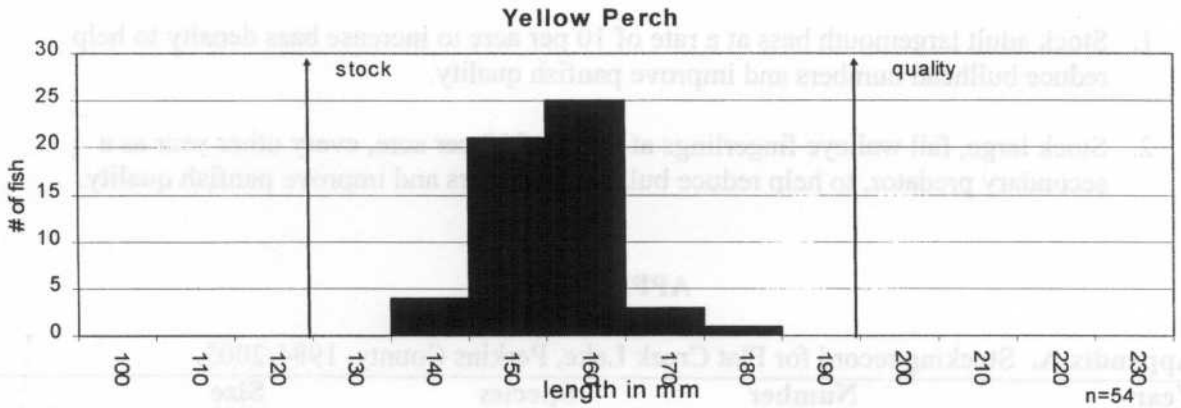


Figure 7. Length frequency histograms for yellow perch from frame nets in Flat Creek Lake 2003.

Table 5. Flat Creek Reservoir yellow perch year class, age in 2003, sample size (N), mean back-calculated length (mm) at age, population mean length at age in 2003 with standard errors in parentheses, and the South Dakota mean length at age (Willis et al. 2001).

Year Class	Age	N	Age 1	2	3	4
2001	2	2	86	130		
2000	3	5	78	121	148	
1999	4	1	92	125	153	170
Mean(SE)		8	**85(4)**	**126(3)**	**151(2)**	**170(0)**
S.D. Mean			86(2)	145(4)	190(5)	220(5)

Other fish species

Three other fish species were collected during sampling; green sunfish x bluegill hybrids, common carp and white sucker. The common carp population is substantial with a frame net CPUE of 2.3 and a gill net CPUE of 6.0. In 2000, CPUE was 0.3 and 15.0, respectively.

LITERATURE CITED

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Willis, D.W., D.A. Isermann, M.J. Hubers, B.A. Johnson, W.H. Miller, T.R. St. Sauver, J.S. Sorenson, E.G. Unkenholz, and G.A. Wickstrom. 2001. Growth of South Dakota Fishes

RECOMMENDATIONS

1. Stock adult largemouth bass at a rate of 10 per acre to increase bass density to help reduce bullhead numbers and improve panfish quality.

2. Stock large, fall walleye fingerlings at a rate of 10 per acre, every other year as a secondary predator, to help reduce bullhead numbers and improve panfish quality.

APPENDICES

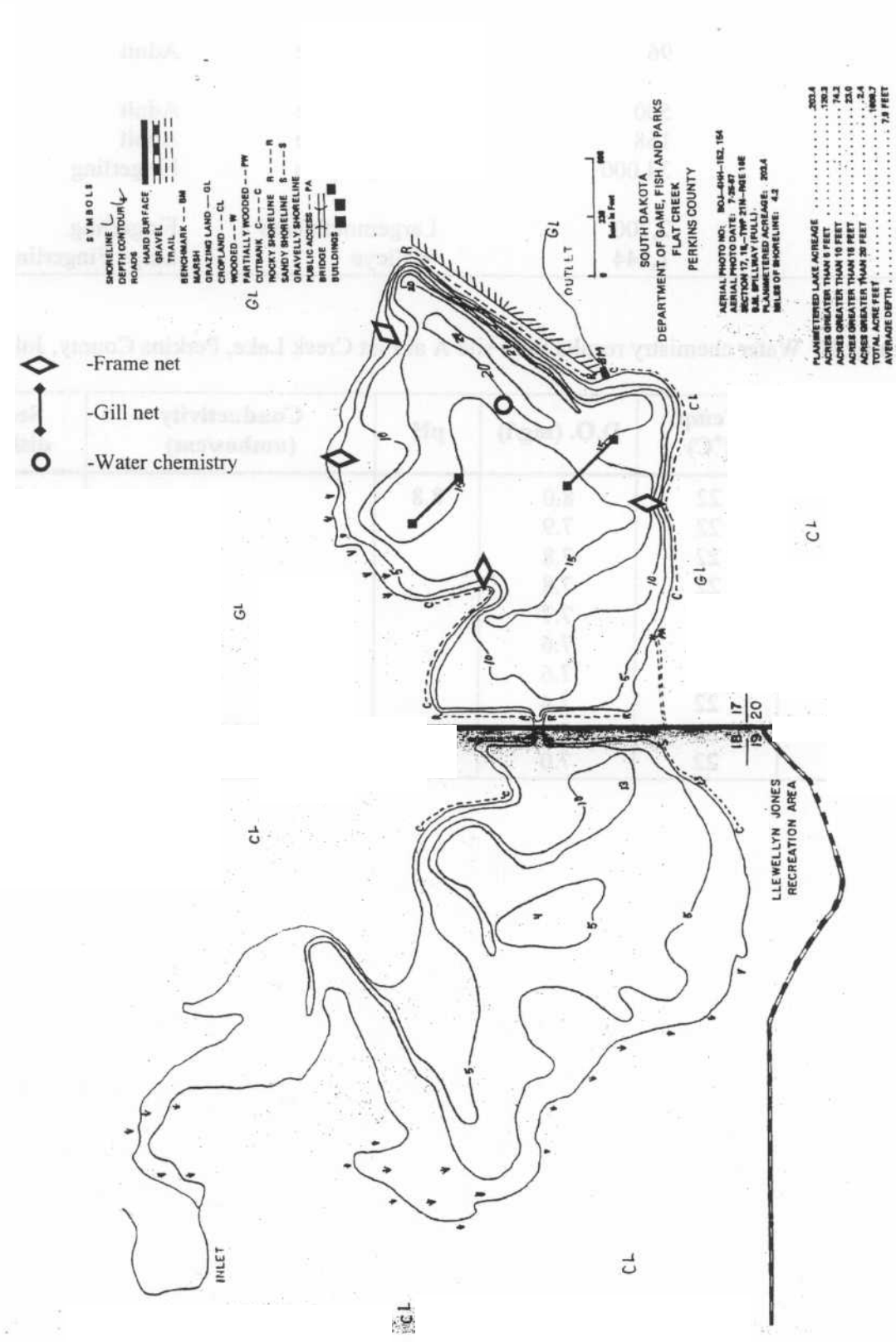
Appendix A. Stocking record for Flat Creek Lake, Perkins County, 1984-2003.

Year	Number	Species	Size
1984	12	Northern pike	Adult
	24	Walleye	Adult
	4	Channel catfish	Adult
	400	Black crappie	Adult
1985	500,000	Walleye	Fry
1986	600	Bluegill	Juvenile
	500,000	Walleye	Fry
1987	450	Black crappie	Adult
	90	Largemouth	Adult
1988	9,265	Northern pike	Fingerling
1991	20,000	Walleye	Fingerling
1995	78	Northern pike	Adult
	115	Northern pike	Adult
	150	Northern pike	Adult
	400	Black crappie	Adult
	4,500	Largemouth bass	Fingerling
1996	500	Black crappie	Adult
	17,000	Northern pike	Fingerling
	86	Northern pike	Adult

	96	Northern pike	Adult
1997	500	Black crappie	Adult
	168	Northern pike	Adult
	34,000	Northern pike	Fingerling
2003	2,700	Largemouth bass	Fingerling
	1,144	Walleye	Large Fingerling

Appendix B. Water chemistry results from site A at Flat Creek Lake, Perkins County, July 10, 2003

Depth (ft)	Temp (°C)	D.O. (mg/l)	pH	Conductivity (*u*mhos/cm)	Secchi disk (ft)
Surface	22	8.0	8.8		3.0
2	22	7.9			
4	22	7.8			
6	22	7.8			
8	22	7.7			
10	22	7.6			
12	22	7.6			
14	22	7.4			
16	22	7.3			
18	22	7.0			



Appendix C. Sampling locations at Flat Creek Lake.

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-36

Name: Shadehill Reservoir County: Perkins
Legal description: T 21N, R 15E Sec. 1,2,3,4,8,9,10,15,16,17,20,21,22,23,26,27,34,35,
Location from nearest town: 12 miles south of Lemmon, SD
Dates of present survey: July 15; August 18-20, 2003
Date last surveyed: July 15-16; August 19-21; October 8, 2002
Most recent lake management plan: F21-R-30 Date: 1997
Management classification: Warmwater permanent
Contour mapped: Date: July 1985

Primary Species: (game and forage)	Secondary and other species:
1. Walleye	1. Northern pike
2. Smallmouth bass	2. Bluegill
3. Channel catfish	3. White bass
4. Black crappie	4. Spottail shiner
5. Yellow perch	5. Carp
6. Emerald shiner	6. River carpsucker
7. Gizzard shad	7. Northern redhorse
8.	8. White sucker
9.	9. Rainbow trout

PHYSICAL CHARACTERISTICS

Surface Area: 4,693 acres; Watershed: 2,176,000 acres
Maximum depth: 62 feet; Mean depth: 21.8 feet
Lake elevation at survey (from known benchmark): unknown

1. Describe ownership of lake and adjacent lakeshore property:

Shadehill Reservoir was built, maintained and operated by the U.S. Bureau of Reclamation. South Dakota Department of Game, Fish and Parks maintains a recreation area/campground and game production area along much of the shoreline.

2. Describe watershed condition and percentages of land use:

The Shadehill Reservoir watershed is approximately 3,400 square miles, 75% of which is pasture and grassland, 20% agricultural cropland, and 5% forest and park land.

3. Describe aquatic vegetative condition:

Due in part to its contour and yearly water level fluctuations, Shadehill Reservoir has limited emergent and submergent vegetation. Indigenous species to the reservoir are coontail, common cattail, potomageton spp. and willow.

4. Describe pollution problems:

Department personnel identified no pollution problems during the 2003 survey.

5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:

All access and regulatory structures are in excellent condition. There is a well kept state park that provides excellent facilities on Shadehill Reservoir.

CHEMICAL DATA

1. Describe general water quality characteristics.

Water chemistry parameters were collected on August 18, 2003 at 3 established stations (Appendix C). Field measurements included temperature, dissolved oxygen, conductivity, pH and transparency (Appendix A). Water samples were collected from the surface using 2 liter sampling bottles and sent to the laboratory for total phosphorus and chlorophyll A analysis. No obvious problems were identified from the results of this testing. Secchi depth, chlorophyll A, and total phosphorous values were combined for all three sites and mean values were used to calculate the Trophic State Index (TSI) (Carlson 1977) of Shadehill Reservoir. The TSI ranking is from 1-100. Lakes with low TSI values (<40) are considered oligotrophic, lakes with values between 40 and 50 are considered mesotrophic and those with higher values (>50) indicate eutrophic conditions. TSI results from 1993 to 2003 are shown in Table 1.

2. Thermocline: No

3. Secchi disc reading: Station 1= 0.9m; Station 2= 1.1m; Station 3= 1.5m; mean= 1.2m

4. Stations for water chemistry located on attached lake map: Yes

Station 1=Dam grade, Station 2=North Fork, Station 3=South Fork

Table 1. Trophic State Indices (TSI) of Shadehill Reservoir 1993-2003. Indices include secchi depth (SD), chlorophyll A (Chl A), total phosphorus (TP) and mean TSI.

TSI Values	1993	1995	1996	1997	1998	1999	2000	2001	2002	2003
SD	41	45	57	32	46	49	56	50	61	57
Chl A	67	41	36	33	31	37	57			
TP	47	51	37	47	37	57	55	58	59	55
Mean TSI	51	46	43	37	42	**48**	**56**	**54**	**60**	**56**

BIOLOGICAL DATA

Methods

Age-0 fish were collected with a 6.4 mm (1/4 in) mesh bag seine, measuring 30.5 m (100 ft) long and 1.8 m (6 ft) deep. Seining was conducted on July 15, 2003 at 4 established stations (Appendix C). Within each sampling station, 2 seine hauls were made. Each seine haul covered 0.2 acres for a total of 1.6 acres lake wide. All fish collected were identified, counted, and classified as "age-0" or "other".

A lake survey was conducted on Shadehill Reservoir August 18-20, 2003. Sampling consisted of 4 gill net nights and 6 trap net nights (Appendix C). All gill nets were monofilament experimental nets. Each net was 91.4-m (300-ft) long and 1.8-m (6-ft) deep with six 15.2-m (50-ft) panels of bar mesh sizes: 12.7-mm (1/2-in), 19.1-mm (3/4-in), 25.4-mm (1-in), 31.8-mm (1 '/4-in), 38.1-mm (1 '/2-in), and 50.8-mm (2-in). Trap nets were set at six stations consisting of 1 trap net nights each. All trap nets were modified fyke-nets with a 1.3-X 1.5-m frame, 19.1-mm (3/4-in) mesh and a 1.2- X 23-m (3.9- X 75.5-ft) lead. Collected fish were measured for total length (TL; mm) and weighed (g). In addition, scale samples for the first five fish per centimeter group were collected from selected fish per gear type for age and growth analysis. Scale samples were pressed onto acetate slides and viewed with a microfiche projector (40X) and the distance between scale annuli were recorded on paper strips. All data was entered into WinFin 2.95 (Francis 1999).

Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch-per-unit-effort (CPUE; number of fish collected per net night or number of fish collected per hour of electrofishing), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr) based on length categories. Abundance was expressed as the mean catch-per-unit-effort (CPUE; mean number per net night). Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr.

RESULTS AND DISCUSSION

Age-0 Fish Survey

Arch Seining

A total of 521 young of the year fish were sampled during the seining survey (Table 2). Yellow perch were most abundant with 67% of the age-0 fish, spottail shiners were second with 18% and gizzard shad were third with 7% (Table 2). Last year only 26 young of year were sampled with twice the effort.

Table 2. Field form depicting total catch by station of 1/4 arc seine pulls, Shadehill Reservoir, July 15-16, 2002.

1/4 Arc Seine Field Form

Lake: Shadehill Reservoir — Seine Measurements; Length: 100 ft
County: Perkins River — Depth: 6 ft
Date: July-15, 2003 — Mesh Size: 1/4 inch square
Collected By: Miller, Keeton, Switzer

	Station 1		Station 2		Station 3		Station 4		TOTAL	
Spp.	**Age-0**	**1+**	**Age-0**	**1+**	**Age-0**	**1+**	**Age-0**	**1+**	**Age-0**	**1+**
BLC	1		2						**3**	
CAP							2		**2**	
CCF				2	11	4			**11**	**6**
EMS		78		26	14	73		453	**14**	**630**
JOD	2		2						**4**	
GZD					38				**38**	
SHR				1		1		7		**9**
SPS			93	62		113	1	1	**94**	**176**
WAE						2				**2**
WHB		1		4	5	12		19	**5**	**36**
YEP	331		17	1			2		**350**	**1**
Total	**334**	**79**	**114**	**96**	**68**	**205**	**5**	**480**	**521**	**860**

Fish Community Survey

Gill and Trap Net Catch

Fourteen species were collected in the gill nets during the 2003 lake survey of Shadehill Reservoir, for a total of 681 fish. White bass were the most abundant species comprising 43.0% of the total, while channel catfish were second most abundant at 20.4% and gizzard shad were third with 13.2%.

Trap nets sampled twelve species for a total of 120 fish in 2003. Black crappie comprised 47.5% of the total number with walleye being second most abundant with 8.3%. Bluegill were tied for the third most abundant species comprising 7.5% of the total catch.

Table 3. Total catch (N), catch per net night (CPUE; 80% Cl's in parentheses), catch per net night of stock length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD; 90% Cl's in parentheses), and fish condition for fish larger than stock length (Wr>S; 90% CI's in parentheses) for all fish species collected from four, 300-ft experimental sinking gill nets in Shadehill Reservoir, Perkins County, 2002.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr>S
Black crappie	1	0.3(0.4)	0.3(0.4)	--	--	109.1(--)
Channel catfish	139	34.8(14.9)	21.0(16.4)	48(9)	--	90.6(0.9)
Common carp	27	6.8(5.2)	6.8(5.2)	74(15)	11(11)	91.3(2.1)
Freshwater drum	10	2.5(1.4)	2.5(1.4)	0(--)	0(--)	103.3(3.8)
Goldeye	4	1.0(1.2)	1.0(1.2)	--	--	--
Gizzard Shad	90	22.5(20.4)	3.5(2.5)	100(--)	--	101.4(4.1)
Northern pike	14	3.5(3.6)	3.0(2.8)	100(--)	42(27)	84.4(4.6)
River carpsucker	8	2.0(1.3)	2.0(1.3)	100(--)	100(--)	92.6(5.4)
Shorthead redhorse	4	1.0(1.2)	1.0(1.2)	--	--	82.4(5.7)
Spottail shiner	1	0.3(0.4)	0.3(0.4)	--	--	--
Walleye	70	17.5(7.2)	9.0(5.7)	31(14)	3(4)	84.6(1.2)
White bass	293	73.3(72.9)	73.3(72.9)	91(3)	1(1)	87.6(0.6)
White crappie	10	2.5(3.0)	2.5(3.0)	100(--)	0(--)	95.8(2.5)
Yellow perch	10	2.5(1.6)	2.5(1.6)	50(31)	10(18)	87.6(1.9)
Totals	**681**					

Table 4. Total catch (N), catch per net night (CPUE; 80% Cl's in parentheses), catch per net night of stock-length fish (CPUE-S; 80%Cl's), proportional stock densities (PSD, RSD; 90% Cl's in parentheses) and fish condition for fish larger than stock-length (Wr>S; 90% Cl's in parentheses) for all fish species collected from 6 modified-fyke trap nets in Shadehill Reservoir, Perkins County, 2003.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr>S
Black crappie	57	9.5(3.3)	9.5(3.3)	51(11)	2(3)	101.8(1.4)
Bluegill	9	1.5(1.5)	1.5(1.5)	67(31)	22(28)	114.5(26.7)
Channel catfish	3	0.5(0.7)	0.5(0.7)	--	--	--
Common carp	1	0.2(0.2)	0.2(0.2)	--	--	--
Freshwater drum	7	1.2(0.9)	1.2(0.9)	--	--	102.4(1.1)
Northern pike	5	0.8(0.7)	0.8(0.7)	100(-)	40(52)	--
River carpsucker	6	1.0(1.2)	1.0(1.2)	--	--	80.8(--)
Shorthead redhorse	3	0.5(0.5)	0.5(0.5)	--	--	81.9(--)
Smallmouth bass		1.3(1.5)	1.0(1.0)	0(-)	0(-)	86.8(5.7)
Walleye	10	1.7(1.0)	1.3(0.7)	63(34)	25(31)	78.7(--)
White bass	7	1.2(1.1)	1.2(1.1)	57(39)	29(35)	--
White crappie		0.7(0.7)	0.7(0.7)	75(59)	0(-)	92.0(7.9)
Totals	120					

Black crappies

Black crappie trap net CPUE was 9.5 per net for stock length and larger fish (Table 4). Stock indices increased to a PSD of 51 and an RSD-P of 2, compared to 10 and 0 last year, respectively (Table 5). Crappie condition was excellent with a mean Wr for stock length and larger fish of 101.8 (Table 4). The length frequency shows the 2001 year class ranges from 170 to 210 mm (Figure 1). It appears growth is excellent, well above the state average (Table 6).

Table 5. Composite listing of sample size (N), catch per unit effort (CPUE; 80% confidence intervals are given in parentheses), and proportional stock densities (PSD, RSD; 90% CI's are given in parentheses) for black crappie collected by trap nets in Shadehill Reservoir, 2000-2003.

Year	N	CPUE	PSD	RSD-P
2000	16	1.3(0.8)	69(21)	50(23)
2001	16	1.5(0.6)	47(23)	20(19)
2002	42	5.3(2.8)	10(8)	0(na)
2003	57	9.5(3.3)	51(11)	2(3)

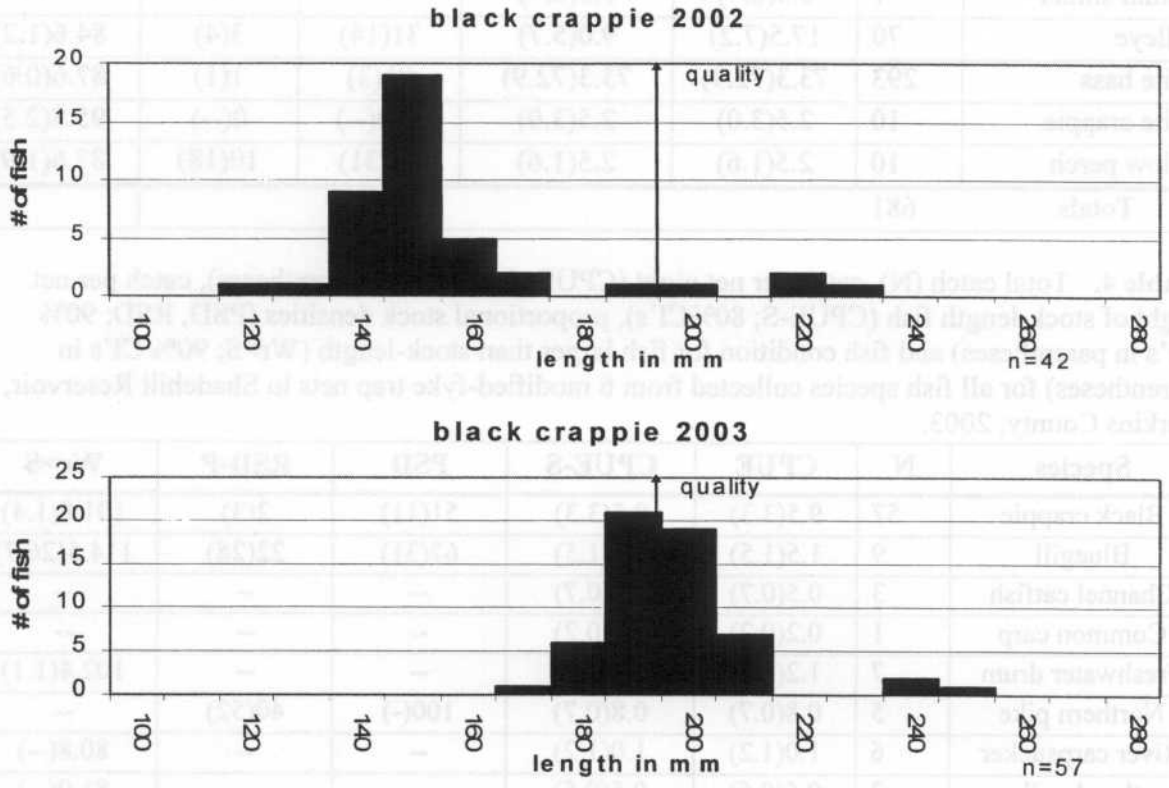


Figure 1. Length frequency histogram for black crappie from frame nets at Shadehill Reservoir, 2002-2003.

Table 6. Shadehill Reservoir black crappie year class, age in 2003, sample size (N), mean back-calculated total length at age, and the South Dakota state-wide black crappie mean length at age (Willis et al 2001).

Year Class	Age	N	Age 1	2	3
2001	2	18	104	167	
2000	3	2	81	160	236
2003 mean (SE)		**30**	**92**	**164**	**236**
South Dakota (SE)			83 (2)	147 (4)	195 (5)

Channel Catfish

Channel catfish continue to be the most abundant species sampled in gill nets with a CPUE of 34.8. This is similar to last year's CPUE of 29.3. PSD was 48 with not a single fish over preferred length (Table 7). It's puzzling how none of these abundant catfish ever reach larger sizes. Possibly, our gear does not sample the larger fish. Past data shows few if any catfish ever reach preferred length. Condition was low with a mean Wr for stock length and larger fish of 90.6 (Table 3). This steady population seems to have very little changes year after year (Table 7).

Table 7. Composite listing of sample size (N), catch-per-unit-effort (CPUE; 80% confidence intervals are given in parentheses), and proportional stock densities (PSD, RSD; 90% CI's are given in parentheses) for channel catfish collected by gillnets in Shadehill Reservoir, 1999-2003.

Year	N	CPUE	PSD	RSD-P
1999	261	29.0(12.0)	27(5)	0(1)
2000	163	27.2(4.6)	32(6)	1(1)
2001	97	19.4(11.3)	36(9)	0(na)
2002	117	29.3(17.3)	56.0)	0(na)
2003	139	34.8(14.9)	48(9)	0(na)

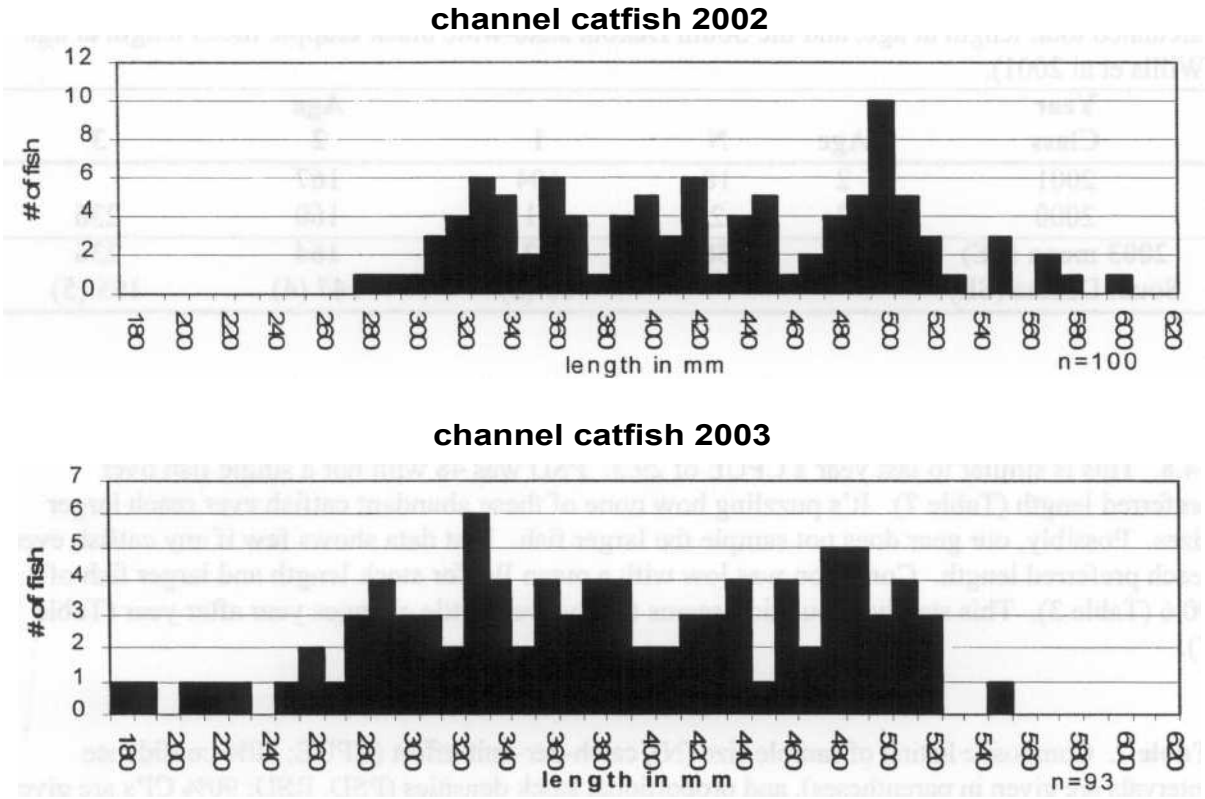


Figure 2. Length frequency for channel catfish from gillnets at Shadehill Reservoir 2002-2003.

Gizzard Shad

Our 251 adult shad stocked this spring appear to have had an excellent spawn (Figure 3). CPUE was 22.5 per gill net. Young of the year per net was 19.0. In 2002, CPUE was 0.0. These shad should provide excellent forage for Shadehill's predatory fish.

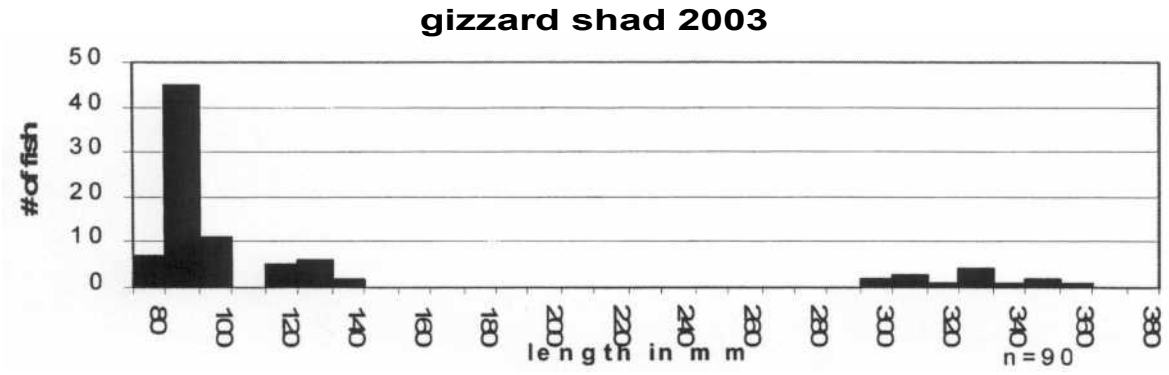


Figure 3. Length frequency histogram for gizzard shad from gill nets in Shadehill Reservoir, 2003.

Smallmouth bass

No electrofishing was done at Shadehill, so smallmouth data is very limited. Eight fish were sampled in the six frame nets none of which were over quality length.

Walleye

Our walleye sample showed a slight increase in abundance over last year's sample. Gill net CPUE was 17.5 compared to 9.0 last year (Table 8). Catch for stock length and larger fish was almost identical with a CPUE of 9.0 compared to 8.5 last year. PSD for this sample was 31, which is down from 82 last year. Fish over 20 inches remain low, with an RSD-P of 3, which is up from 0 last year. Length frequency histogram shows a good number of small fish below 14 inches. A one fish over twenty inches regulation was put in place for 2003, hopefully protecting some of these fish and helping improve size structure. Growth was slow but appears to be improving in recent years, probably the results of the gizzard shad introduction (Table 9). Fish condition was low with stock length and larger fish having a mean Wr of 84.6 (Table 3).

Table 8. Composite listing of sample size (N), catch-per-unit-effort (CPUE; 80% confidence intervals are given in parentheses), mean total length (TL; standard error is given in parentheses), and proportional stock densities (PSD, RSD; 90% Cl's are given in parentheses) for walleye collected by gill net in Shadehill Reservoir, 1994-2003.

Year	N	CPUE	CPUE-S	PSD	RSD-P
1994	122	10.2		12	0
1995	129	10.8		24	2
1996	134	14.8		32	2
1997	91	10.1		12	2
1998	56	6.2		5	0
1999	64	7.1		0	0
2000	122	20.3 (6.9)	20.3 (6.9)	9(4)	2(2)
2001	93	18.6 (10.1)	17.4 (10.2)	31(8)	0 (na)
2002	42	10.5(5.1)	8.5(3.4)	82(12)	0 (na)
2003	70	17.5(7.2)	9.0(5.7)	31(14)	3(4)

Table 9. Shadehill Reservoir walleye year class, age in 2003, sample size (N), mean back-calculated total length at age, population standard error (SE), the Region 1 and South Dakota walleye mean length at ages (Willis et al. 2001).

Year			Age							
Class	**Age**	**N**	**1**	**2**	**3**	**4**	**5**	**6**	7	8
2002	1	25	168							
2001	2	16	166	247						
2000	3	8	132	270	324					
1999	4	1	117	201	308	350				
1998	5	5	**117**	183	260	369	427			
1997	6	2	122	188	227	300	409	456		
1996	7	2	135	171	215	283	336	382	432	
1995	8	1	126	235	289	378	378	423	475	501
Mean (SE)		**60**	**135(7)**	**213(14)**	**271(18)**	**327(16)**	**387(20)**	**420(21)**	**453(22)**	**501(0)**
Region 1			164(17)	260(22)	332(27)	385(32)	444(42)			
South Dakota			168(3)	279(6)	360(7)	425(8)	490(9)			

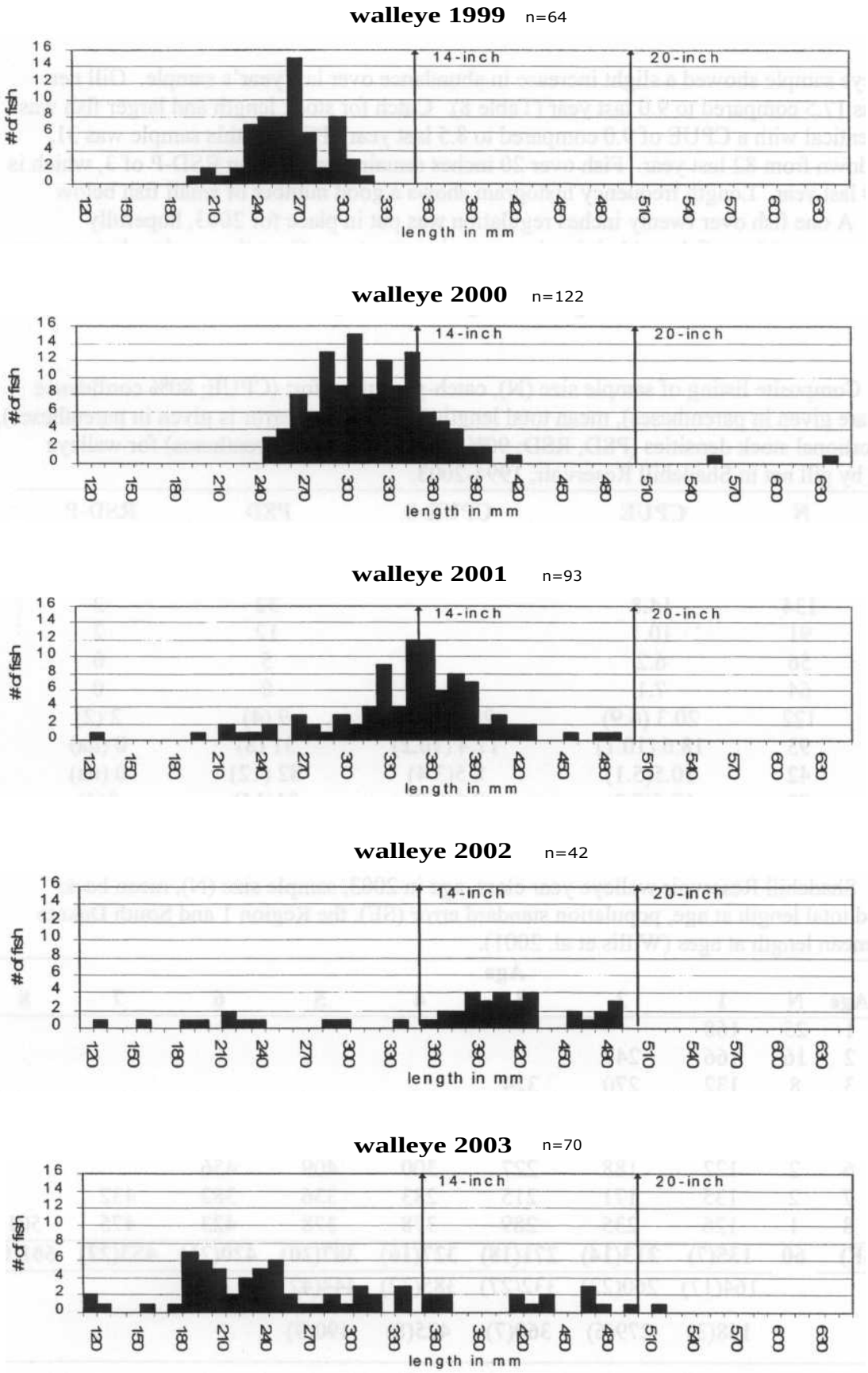


Figure 4. Length frequency histograms for walleye from gillnets at Shadehill from 1999-2003.

White Bass

White bass abundance has increased dramatically since last year. Gill net CPUE was 73.3 for stock length and larger fish, last year it was 12.8 (Table 3). PSD was 91 with an RSD-P of 1. Last year PSD was 63 with an RSD-P of 35. Fish condition was average with a Wr for stock length and larger fish of 87.6.

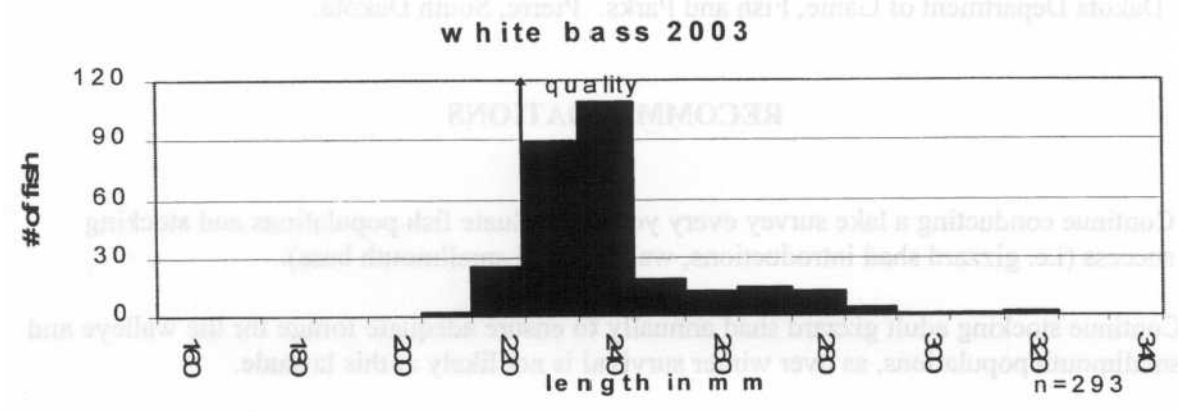


Figure 5. Length frequency histograms of white bass collected by gillnet in Shadehill Reservoir from 2003.

Table 10. Composite listing of sample size (N), catch per unit effort (CPUE; 80% confidence intervals are given in parentheses), and proportional stock densities (PSD, RSD; 90% Cl's are given in parentheses) for white bass collected by gillnets in Shadehill Reservoir, 1999-2003.

Year	N	CPUE	PSD	RSD-P	Wr>S
1999	13	1.4(0.9)	100(-)	25(31)	77.7(0.6)
2000	44	7.3(7.0)	98(4)	23(11)	83.0(0.8)
2001	93	18.6(22.9)	91(10)	74(16)	88.0(2.0)
2002	51	12.8(8.9)	63(13)	35(12)	85.6(1.1)
2003	293	73.3(72.9)	91(3)	1(1)	87.6(0.6)

Other fish species

Ten other fish species were collected during the annual lake survey bluegill, common carp, freshwater drum, goldeye, northern pike, river carpsucker, shorthead redhorse and spottail shiner, white crappie, and yellow perch. Other species listed had low catch rates (Tables 3 and 4). According to past surveys, this is normally the case with these species.

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RECOMMENDATIONS

1. Continue conducting a lake survey every year to evaluate fish populations and stocking success (i.e. gizzard shad introductions, walleye, and smallmouth bass).

2. Continue stocking adult gizzard shad annually to ensure adequate forage for the walleye and smallmouth populations, as over winter survival is not likely at this latitude.

APPENDICES

Appendix A. Water chemistry results from sites 1, 2, and 3 Shadehill Reservoir, Perkins County, August 19, 2002.

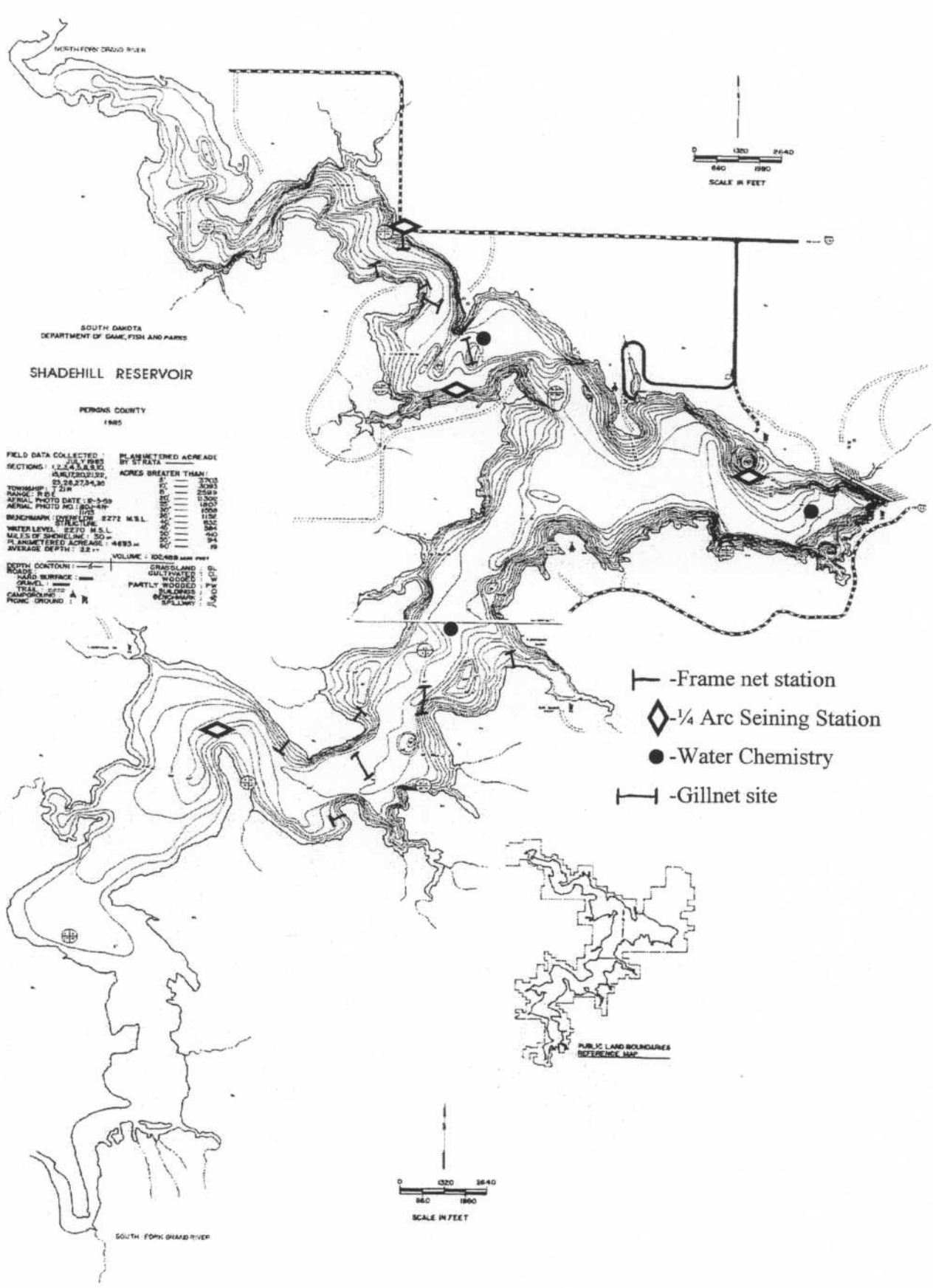
Site	Depth (ft)	Temp (°C)	D.O. (mg/l)	pH	Conductivity (umhos/cm)	Secchi disk (ft)
1	surface	24.3	7.9	8.9	1956	3
	1.0	24.3	7.9	8.9	1955	
	4.2	24.3	7.9	8.9	1954	
	5.5	24.3	7.9	8.9	1953	
	7.2	24.3	7.9	8.9	1952	
	10.9	24.2	7.9	8.9	1949	
	13.4	24.1	7.8	8.9	1946	
	15.1	24.1	7.7	8.9	1946	
	17.1	24.1	7.7	8.9	1945	
	19.9	24.1	7.6	8.9	1944	
	22.0	24.1	7.6	8.9	1944	
	24.8	23.9	7.5	8.9	1931	
	27.5	23.4	7.4	8.9	1903	
	30.8	23.0	7.1	8.9	1890	
	34.0	22.8	7.0	8.8	1885	
	37.4	22.7	6.8	8.8	1880	
	40.6	22.6	6.7	8.8	1868	
	43.5	22.0	6.5	8.8	**1817**	
	47.2	21.2	6.0	8.6	1777	
	48.6	19.6	2.8	7.9	1681	

2	surface	23.4	7.7	8.9	1921	3
	2.0	23.4	7.7	8.9	1920	
	4.2	23.4	7.6	8.9	1920	
	6.3	23.4	7.6	8.9	1919	
	8.5	23.3	7.6	8.9	1919	
	10.3	23.3	7.6	8.9	1918	
	13.8	23.3	7.5	8.9	1918	
	16.9	23.3	7.5	8.9	1916	
	18.9	23.3	7.5	8.9	1916	
	21.5	23.2	7.5	8.9	1912	
	24.3	23.1	7.4	8.9	1910	
	27.2	23.1	7.3	8.9	1905	
	29.8	22.9	7.1	8.8	1895	
	31.3	22.5	5.8	8.2	1875	
3	surface	23.1	6.7	8.9	1906	4.5
	1.2	23.1	6.6	8.9	1905	
	4.8	23.1	6.6	8.9	1903	
	8.3	23.0	6.6	8.9	1898	
	10.8	22.8	6.5	8.9	1892	
	14.1	22.8	6.5	8.9	1888	
	17.1	22.7	6.4	8.9	1888	
	20.2	22.7	6.3	8.9	1886	
	23.0	22.7	6.3	8.9	1885	
	26.6	22.7	6.3	8.9	1878	
	28.8	22.5	6.1	8.7	1844	
	29.3	22.4	6.1	8.5	1799	

Appendix B. Stocking record for Shadehill Reservoir, Perkins County, 1990-2003.

Year	Number	Species	Size
1990	31,000	Walleye	Fingerling
	400	Yellow perch	Adult
1991	5,000,000	Walleye	Fingerling
1992	20,000	Northern pike	Fingerling
	200,000	Walleye	Fingerling
1993	5,000,000	Walleye	Fry
	200,000	Walleye	Fingerling
1994	200,000	Walleye	Fingerling
1995	25,000	Rainbow trout	Fingerling
1996	25,000	Rainbow trout	Fingerling
	50,550	Smallmouth bass	Fingerling
	393,000	Walleye	Fingerling

1997	24,053	Rainbow trout	Fingerling
	57,300	Smallmouth bass	Fingerling
	194,772	Walleye	Fingerling
1998	51,666	Smallmouth bass	Fingerling
	400	Yellow perch	Adult
1999	96	Gizzard shad	Adult
	50,000	Smallmouth bass	Fingerling
	150,918	Walleye	Fingerling
	6,750	Yellow perch	Adult
2000	251	Gizzard shad	Adult
	30,590	Smallmouth bass	Fingerling
2001	57	Gizzard shad	Adult
	138,075	Walleye	Fingerlings
2002	50,000	Walleye	Fingerlings
2003	251	Gizzard shad	Adult



Appendix C. Locations of sampling sites on Shadehill Reservoir.